A Comprehensive Study on the Performance of Hong Kong Mandatory Provident Funds (MPF)

A thesis submitted in fulfillment of the requirements for
the degree of

DOCTOR OF PHILOSOPHY IN ECONOMICS AND FINANCE

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December 2006

DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

Patrick Chu Kuok-kun

12 December 2006

ACKNOWLEDGEMENTS

The author is appreciative and thankful to Professor Michael McKenzie for his guidance, patience, and support throughout the preparation of this dissertation. The author also benefited very much from the Research Development Unit and School of Economics, Finance and Marketing of RMIT for giving lenient help during the candidature; the Lipper Asia Limited for providing time series data; and the library of University of Macau and the library of the University of Hong Kong for facilitating the current research with materials and other means.

Finally, the author owes special gratitude to Miss Irene Cheong, Pastor and the Christians in Macau GIG-Life Church. Their sacrifice, patience, and support have made the process of writing the dissertation much easier than it would have been otherwise.

ABSTRACT

This thesis represents the first comprehensive study on the performance (raw and risk-adjusted), performance persistence, and market timing ability of the equity funds in Hong Kong Mandatory Provident Funds (MPF) scheme during the period 2001 – 2004. Regardless of the measure used (Jensen single-index alpha measure, Fama-French three-factor alpha measure, and modified Jensen alpha controlled by changes in exchange rates), US equity funds and Pacific-Basin excluding Japan equity funds, are found to consistently underperform relative to the market. The tracking errors indicate the HSI tracking funds may not exactly replicate the returns of the benchmark index and they exhibit March seasonal effect. Nonparametric two-way contingency table and parametric OLS regression analysis are employed to evaluate performance persistence. The evidence suggests that the raw returns, Jensen alpha, Fama-French alpha, and their rankings in the previous year possess predictive abilities. When the funds are classified into high-volatility and low-volatility samples, the high-volatility funds are found to possess stronger performance persistence. Neither hot-hand nor cold-hand phenomena are found in the equity funds managed by the same investment manager. The market timing models, Treynor-Mazuy and Henriksson-Merton, provide evidence of market timing ability. The ability of MPF constituent equity funds to successfully time the market in times of changing economic condition is also investigated. The evidence is consistent with previous studies which suggest that the conditional models increase the individual fund traditional alpha measure. Regarding the fund managers' market timing ability, the proportion of MPF funds with negative timing coefficients is higher when conditioned on public information. Finally, the market timing models with the addition of higher-order terms are found more appropriate.

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CHAPTER 1 INTRODUCTION

1.1 Introduction to Fund Investment in Hong Kong

Hong Kong is one of the major financial centers in the world. Following the trend in many western countries, mutual funds are playing an increasingly important role in Asian financial markets. The net asset value (NAV) of fund houses, which are authorized to sell mutual funds in Hong Kong, by the Hong Kong Securities and Futures Commissions (HKSFC) has increased from US$18.3 billion in 1990 to US$551.2 billion as at December 2004.

Individuals invest in mutual funds for three main reasons: (1) management: professional investment managers are expected to have better investment abilities than individuals; (2) diversification of risk: mutual funds provide individual investors the opportunity to achieve better diversification with only small amounts of capital; and (3) availability: there is a wide variety of funds with different investment objectives for individual investors to choose from, such as balanced funds, equity funds, bond funds, and relatively higher risk hedge funds.

The first fund house that offered actively managed funds in Hong Kong was the Hong Kong and Shanghai Banking Corporation, which has been providing professional portfolio management services since 1960. Nowadays, the organizations that offer mutual funds include the investment management department of life insurance companies, investment companies, investment advisory services and institutional investors of trust departments in large commercial banks. The Hong Kong Unit Trust Association (HKUTA), which was renamed the Hong Kong Investment Fund Association (HKIFA) in 1993, was set up in 1985 to monitor the business of mutual fund industry.

In December 2000, a new form of managed fund appeared in the Hong Kong financial markets. The Hong Kong Mandatory Provident Fund (MPF) was created as a result of a government initiative to boost the retirement funds of Hong Kong workers. It is required by the government that all workers have to delegate 5% of their salary to this new system of pension funds. Thereby, an examination of Hong Kong MPF becomes that focus of this study.

1.2 Overview of Mandatory Provident Funds in Hong Kong

Background of the System

Many international organizations have considered the problem of an ageing population and most have also proposed some form of policy. According to the 1994 World Bank study "Averting the Old-Age Crisis: Policies to Protect the Old and Promote Growth", governments should protect the old and they should promote economic growth. The World Bank suggested that the ageing population security programs might be achieved by adopting a 'three pillars' program, which consists of:

1. Publicly managed, tax-financed social safety net for the old;
2. Mandatory, privately managed, fully funded contribution scheme; and
3. Voluntary personal savings and insurance.

The Mandatory Provident Fund (MPF) system was implemented in Hong Kong on 1 December, 2000. The main purpose of the system is as an employment-based protection system. The problem of an ageing population has existed in Hong Kong and such problem has been highlighted since 1980's. Statistics showed that people aged 65 and above accounted for 6.6% of the population in 1981. The proportion has grown to 11.5% in 2003, and is expected to increase to 14% by 2016, and to 24% by 2031[1]. This shows that the need for retirement protection is increasing. Before the implementation of the MPF system, only one-third of the 3.4 million Hong Kong workforces had some form of retirement protection. With the implementation of MPF system, 86% of the workforce had retirement protection by the end of 2001, either through MPF or other retirement schemes. Table 1.2.1 shows the summary statistics of the proportion of workforce by type of retirement scheme after its launch and table 1.2.2 presents the summary of the number of members in MPF schemes. These two tables indicate that most of the Hong Kong workforce is under the protection of some certain forms of retirement schemes and more employees have joined the schemes.

[1] Source: Census and Statistics Department, Hong Kong SAR Government

With the implementation of MPF, complemented by personal savings and the Comprehensive Social Security Assistance (CSSA) Scheme operated by Social Welfare Department, Hong Kong now has in place all the three pillars for old-age protection.

Key Features of the MPF System

By law, all employees defined as any full-time and part-time employee who is employed for a continuous period of not less than 60 days under an employment contact, and the self-employed aged between 18 and 65, are required to join the scheme except the followings:

- Self-employed hawkers;
- People covered by pension or provident fund schemes, such as civil servant and subsidized or grant school teachers;
- Members of occupational retirement schemes with exemption certificates;
- Overseas employees who employed in Hong Kong for less than 13 months, who are covered by overseas retirement schemes; and
- Employees of the European Union Office of the European Commission in Hong Kong.

The contribution to the scheme is 5% of an employee's monthly income, which includes wages, salaries, leave pay, fee, commission, bonus, gratuity, and perquisite or allowance, while excludes housing allowance. Self-employed persons also have to contribute 5% of their relevant monthly income. Employees with monthly income less than $5,000[2] are not required to make any contribution but their employers have to contribute 5% of the employees' income. Employees with monthly income more than $20,000 only have to contribute 5% of $20,000, i.e. $1,000, which is the maximum of the mandatory contribution amount.

Types of Schemes

Money deposited in the MPF scheme is invested in the funds managed by the investment managers or fund houses selected and monitored by nineteen MPF

[2] All the amounts quoted in this thesis are in Hong Kong Dollar.

Trustees which are authorized by the MPF Schemes Authority. A major proportion of the trustees are subsidiaries of banks, trust companies, and insurance companies. The trustees jointly provide three different main types of schemes, which include:

- **Master trust scheme:** membership is open to the employees of more than one employer, self-employed persons and persons with accrued benefits transferred from other schemes. The members of this scheme are mostly the employees of small- and medium-sized companies.
- **Employer-sponsored scheme:** membership is limited to the employees of a single employer. Most of the members in this scheme are the employees of large-sized companies.
- **Industry scheme:** established for employees of catering and construction industries with high labor mobility; members of this scheme do not need to change schemes if they change employment within the same industry.

Tables 1.2.3 and 1.2.4 summarize the numbers and net asset values of these different schemes. The tables jointly present that the master trust scheme constitute the largest part in MPF.

The money pooled by employees, employers, and self-employed persons may be invested in a variety of financial instruments and products across different markets. This arrangement is similar to the pension fund schemes in the other countries, where the scheme members may choose the approved constituent funds which invest in different classes of financial instruments such as money market, bond, equity, balanced funds, etc. Tables 1.2.5 and 1.2.6 present the number and net asset values of the constituent funds with different financial instruments invested. Both tables show that most of the scheme participants concentrate their investments in balanced funds; and imply that most of the participants desire to diversify their capital into different class of investment vehicles such as equities, bonds, and other fixed-income investments in order to get a higher risk-adjusted return with moderate risk.

MPF trustees

All the MPF scheme providers must be authorized by the Hong Kong Mandatory Provident Fund Schemes Authority; the providers are named as trustees. As at the end of 2004, nineteen trustees are authorized by MPFA to provide the MPF schemes. The names of these nineteen trustees as at the end of 2004 are summarized in table 1.2.7. The names of the investment managers and the constituent funds included in the schemes provided by these investment managers are summarized in table 1.2.8.

Classifications of the funds

The funds that the participants may choose from may be classified into sixteen groups, according to the classification methods specified by the Hong Kong Investment Funds Association (HKIFA). The classifications and their respective benchmarks are listed in table 1.2.9. Table 1.2.10 summarizes the structure of the benchmark indices that are designed as performance benchmarks of MPF equity funds as at 1 December 2004.

1.3 Research Motives

Prior to the launch of the MPF scheme, mutual funds were not a major investment vehicle in Hong Kong. They constituted only about 10% of the amount invested by local investors.

With the launch of the MPF in Hong Kong on 1 December 2000, all Hong Kong employers and employees have developed an interest in mutual funds. Meantime, the need for research on the measurement of performance of mandatory provident funds becomes higher, as investors may be better informed of the investment choices. So far, there has been a substantial amount of studies done on Hong Kong security markets and futures markets, however, the academic research on the mutual funds industry in Hong Kong, and Hong Kong MPF, in particular, is just beginning to emerge.

After two disappointing years in 2001 and 2002, most of the equity mutual funds and MPF under perform relative to the benchmarks and some even suffered losses. However, the average underperformance does not necessarily mean that all the funds have inferior performance. Whether a select group of MPF may exhibit superior performance is to be of considerable interest to both academics and practitioners. In this study, the Jensen single-index CAPM model and Fama-French three-factor model will be employed to detect whether some MPF exhibit abnormal performance.

The underperformance of MPF is always reported in local media such as financial news in TV and radio, newspaper, and magazines. Nevertheless, there are no detailed studies on the reasons why the performance is so bad. Is it due to poor managers' stock selection abilities and market timing abilities? Is it due to participants' poor ability in selecting good MPF, which leads to the average participants' MPF portfolios to have suffered loss? All of these reasons will be discussed in this study.

The other motive for this study is that fund performance is usually reported by local media in newspaper and magazines in an unadjusted form. Up to now, there are no related studies on the performance of MPF have focused on adjusted returns. In view of this, the adjusted returns will be adopted in this study. The risk-adjusted return is an important parameter for the investor as the pension investors have long-term investment horizon of 15-30 years, returns on investment converge to its average over a long period of time therefore consistent excess performance year-on-year will make a significant impact on the investment portfolio. The adjusted returns will be estimated using Jensen's alpha, and the Fama-French three-factor alpha, which are widely accepted by academics to study the performance of mutual funds.

The problem of confounding variation in mutual fund risks and risk premiums has long been recognized by the literature (Jensen (1972), Grant (1977)). Such variation may cause the traditional approach to estimate Jensen's alpha, which uses unconditional expected returns as the baseline to be unreliable. In this case, common time variation in risks and risk premiums will be confused with average performance. A modified approach that uses the conditional expected returns as the baseline needs to be developed.

This study will contribute to the knowledge on the performance of pension funds. There are two reasons why the study on performance of pension funds is rather important. Firstly, pension managers control a larger portion of the aggregate wealth than do mutual fund managers (Coggin, Fabozzi, and Rahman (1993)). Secondly, pension fund managers and mutual fund managers operate in a different environment.

For example, pension fund managers are reviewed periodically by their clients and independent pension consultants. Further, whereas poor performing mutual fund investors may withdraw their money from the funds at any time, such withdrawals are not usually seen in pension funds (Christopherson, Ferson and Glassman (1998)). Given these differences, it is interesting to compare the performance of the two types of fund managers.

1.4 Research Objectives

This research has three primary objectives:

1. Evaluate the performance of the MPF by using traditional and conditional risk-adjusted measures.
2. Examine the evidence of MPF performance persistences by using both nonparametric and parametric approaches;
3. Examine the market timing ability of the MPF fund managers by using traditional and conditional approaches.

1.5 Scope of the Study

The scope in this study is limited to equity funds authorized by the Mandatory Provident Fund Scheme Authority. The reason of studying equity funds included in the MPF schemes only is that most of the scheme participants and the academics have more interest in investigating whether the active fund managers outperform the benchmarks; while the other types of funds passively form the portfolios according to their prescribed allocation of assets, preserve the capitals, or invest in money markets. The other types of MPF funds: (1) balanced funds, (2) fixed-income funds, (3) money market funds, (4) guarantee return funds, and (5) capital preservation funds, are all excluded from this study. Furthermore, mutual funds that are not included in MPF scheme are excluded even though some of them are authorized by the Hong Kong Monetary Authority to sell in Hong Kong.

1.6 Limitations of the Study

Due to the short history of the MPF scheme, only a relatively small sample is available when compared to countries with developed mutual fund industries. Another limitation of the data is the lack of information about fund operating characteristics such as the fund size, cash flows, and turnover rates. The MPF funds were not required to release this information to the public before November 2005 and prior to this date the fund trustees treated such information as confidential.

1.7 Organization of the Thesis

The thesis is organized in as follows: chapter 2 provides a literature review of CAPM and APT models, as well as previous studies on mutual fund performance, survivorship bias, performance persistence, and market timing. Chapter 3 outlines the model used to evaluate the performance of MPF funds and presents the empirical results. Chapter 4 considers whether evidence of performance persistence exists in MPF data. Chapter 5 summarizes the models used to evaluate the market timing ability of the MPF funds and presents the empirical results on the existence of market timing. Chapter 6 provides a brief summary of the thesis and discusses the directions for future research.

CHAPTER 2 LITERATURE REVIEW

This chapter contains five sections: (2.1) a review of the theory and statistical evidence of asset pricing models; (2.2) a summary of the empirical studies on mutual fund performance; (2.3) a summary of the empirical studies on survivorship bias that arises if some underperforming funds are excluded from the sample; (2.4) a summary of the studies on persistence of mutual fund performance; and (2.5) a summary of the studies on mutual fund managers' market timing ability.

2.1 Asset pricing models

The Capital Asset Pricing Model (CAPM), introduced by Sharpe (1964), Lintner (1965) and Black (1972), has been the major framework used to analyze the cross-sectional variation in expected asset returns for many years. This model assumes that (1) all investors are averse to risk, and maximize their single period expected utility, (2) all investors have identical decision horizons and homogeneous expectations regarding investment opportunities, (3) all investors are able to choose among portfolios solely based on expected returns and variance of returns, (4) all transaction costs and taxes are zero, and (5) all assets are infinitely divisible. Given the additional assumption that the capital market is equilibrium, CAPM reduces to the following expression for the expected one-period return, $E(\tilde{R}_i)$, on any security (or portfolio) *i,* at time period *t*:

$$E(\tilde{R}_{i,t}) = R_{f,t} + \beta_i [E(\tilde{R}_{m,t}) - R_{f,t}], \tag{2.1.1}$$

where $R_{f,t}$ is the one-period risk free interest rate, $\beta_i = \dfrac{\operatorname{cov}(\tilde{R}_{i,t}, \tilde{R}_{m,t})}{\sigma^2(\tilde{R}_{m,t})}$ is the measure of systematic risk, $E(\tilde{R}_{m,t})$ is the expected one-period return on the market portfolio.

CAPM assumes that a single systematic risk, which arises from the basic variability of stock prices in general, is the fundamental determinant of security (or portfolio) returns. Although CAPM has been utilized extensively in empirical work since 1964 and is the basis of modern portfolio theory, subsequent research casts doubt on its ability to explain the empirical constellation of asset returns. Fama and French (1992) evaluate the joint role of market beta, size, earnings-price ratio, leverage, and book-to-market equity in the cross-sectional variation in average returns on NYSE, AMEX, and NASDAQ stocks over the 1963-1990 period. Using the cross-sectional regression approach suggested by Fama and MacBeth (1973), they show that the relation between the market beta (β_i) and the average return is low, even when β_i is the only explanatory variable. They conclude that (1) the market beta does not play a role in explaining the cross-sectional variation in average stock returns; (2) size and the book-to-market ratio proxy for the roles of leverage and the earnings-to-price ratio in asset pricing. Furthermore, Fama and French (1996) find that the three-factor model in Fama and French (1993), instead of one-factor CAPM, may capture most of the well-documented anomalies. As the ability of CAPM to measure the relationship between risk and return is low, many journals that earlier had chronicled the ascendancy of beta now published articles with titles such as "The Death of Beta," "Bye, Bye Beta," and "Beta Beaten" (Malkiel, 2004).

The Arbitrage Pricing Theory (APT) formulated by Ross (1976) offers a testable alternative to the well-known Capital Asset Pricing Model (CAPM). The CAPM is based upon the entire universe of assets, while the APT model considers subsets of assets and renders information regarding relative pricing. Indeed, the APT is based on a linear return generating process and requires no utility assumptions beyond monotonicity and concavity. It is not restricted to a single period; it will hold in both the multiperiod and single period cases. Unlike the CAPM, the assumption that the market portfolio should be mean variance efficient is not required in the APT.

The APT assumes returns conform to a k-factor linear model:

$$R_i = E(R_i) + \beta_{i1}\delta_1 + \cdots + \beta_{ik}\delta_k + \varepsilon_i, \tag{2.1.2}$$

where R_i is the random return on asset i, $E(R_i)$ is the expected return on asset i, $\beta_{i,k}$ is the sensitivity of asset i to the movements in the kith factor, δ_k is the kth factor common to all assets, and ε_i is the unsystematic risk for asset i.

There are two major differences between the APT and the CAPM. First, and the most obvious, the APT allows more than one return generating factor. Second, the APT demonstrates that since any market equilibrium must be consistent with no arbitrage profits, such equilibrium will be characterized by a linear relationship between each asset's expected return and its return's sensitivity to each of the common factors.

A number of studies have considered the appropriateness of including additional market risk factors. Rosenberg and Marathe (1977) have analyzed what they term "extra-market" components of return by employing extraneous "descriptor variables" to predict intertemporal changes in the parameters in CAPM. They state that "the appropriateness of the multiple-factor model of security returns, with loadings equal to predetermined descriptors, as opposed to a single-factor or market model, is conclusively demonstrated." Langetieg (1978), Lee and Vinso (1980) and Meyers (1973) contain evidence of more than just a single market factor influencing returns. Brennan (1981) describes the APT as "a minimalist model of security market equilibrium" that is "logically prior to our other utility based models, and should be tested before the predictions of stronger utility specifications are considered."

There seems to be sufficient evidence that multiple factors may exist in the returns generating processes of assets. The APT provides a solid theoretical framework for ascertaining whether those factors, if they exist, are "priced," i.e., are associated with risk premia.

The APT embodies two concepts. The first one is the absence of arbitrage which implies a linear pricing relationship. The second one is that the asset-specific risks are diversified away in large portfolios. The weaknesses of the APT are the ambiguity of its empirical implications regarding unique factor identification and the number of factors that may influence the return relationships among securities are not prespecified.

Roll and Ross (1980) apply a three-step procedure to examine the ability of the APT to explain cross-sectional variation in US asset returns during the period 1962-1972. The analysis proceeds in the following stages: firstly, assets are grouped into portfolios. Secondly, a maximum-likelihood factor analysis is performed to estimate the factors and corresponding loadings. Lastly, the factor loadings, or sensitivities, are used as independent variables in a cross-sectional regression. The authors conclude that the APT is unable to be rejected and find that at least three and probably four "priced" factors exist in the generating process of returns of individual stock.

Chang and Lewellen (1985) use both the single-factor CAPM and multi-factor APT to evaluate the performance of 67 equity funds over the period 1971-1979. The authors find that seven factors are needed by statistical factor analysis and the APT is superior to the CAPM as the average adjusted R^2 is higher.

Grinblatt and Titman (1987) introduce extensions of efficient-set mathematics and offer interpretations of the APT pricing equation, and its empirical tests. A significant distinction between the interpretations of mean-variance efficiency in the CAPM and that in the APT is found. They state that the CAPM may reveal that a portfolio is mean-variance efficient, but the information about which portfolios are mean-variance efficient in observable subsets of the economy is not given. The APT pricing equation, on the other hand, may predict which portfolios are locally mean-variance efficient in the subsets of the economy's assets.

Lehmann and Modest (1987) study if the behavior of Jensen's alpha, the intercept of the regression by CAPM or APT, and the Treynor-Black Appraisal Ratios; are influenced by the method used to construct the APT. The authors use four approaches to construct the APT: maximum-likelihood factor-analysis, restricted maximum-likelihood factor-analysis, instrumental-variables factor-analysis, and principal components procedure. The authors find that the Jensen measures and Treynor-Black Appraisal Ratio are quite sensitive to the method used in which different conclusions may be reached. However, the differences in the results are quite small if the number of factors used is different. When comparing standard CAPM with APT, the results show that there are considerable differences. The authors thus conclude that knowing the appropriate model for risk and expected return is very important.

Shukla and Trzcinka (1990) compare the two statistical factor models previously employed in APT: maximum-likelihood factor-analysis and principal components. The authors examine the measurement and pricing errors from both methods and conclude that in some circumstances principal components analysis may be superior to maximum-likelihood factor analysis. They find no difference in the residual variance implied by the two methods, even though factor analysis divides total risk into systematic and unsystematic risk categories and explicitly estimate idiosyncratic risk.

Empirical studies of APT have utilized the factor analysis or principal component methodologies with the assumption of stationary in return variance over time. Koutmos (1993) finds one problem in both approaches. The author studies individual security returns and reports that conditional heteroscedasticity is present in his sample, which leads to inefficient beta estimates. Grouping the securities into portfolios does not overcome this problem.

Academics continue to improve empirical techniques by examining an alternative to the previously employed maximum-likelihood or principal-components-based factor loading models. Subsequent research attempted to construct and identified the important factors underlying the returns. Some academic practitioners tried to specify the priori factors, while these factors are mostly macroeconomic variables, believed to influence the return generating process. The macroeconomic variable approach assumes (1) asset price behavior is linked with external macroeconomic events; and (2) macroeconomic factors can be given economic interpretation. The most attractive feature of the macroeconomic variable approach is that the factors may be economically interpreted.

Chen and Jordan (1993) compare the ability of both principal-component-based statistical factor loading model and macroeconomic factor model based on the APT to predict portfolio returns over the period 1971-1986. The authors find that the differences in test results between the two models are generally relatively small.

Ferson and Korajczyk (1995) also produce a similar result. The authors compare the performance of the macroeconomic factor model with the principal-component-based statistical model. They estimate how much of the predictability in security returns can be explained by these two models for multiple return horizons over the period 1926-1989. They find that the models using five macroeconomic variables, and models using five principal components as the risk factors, have similar overall ability to explain the predictability in security returns.

Connor (1995) compares the explanatory power of three types of factor models: macroeconomic, fundamental, and statistical factor models, using U.S. equity returns data sampled over the period 1985-1993. The author defines (1) the macroeconomic factor model uses economic time-series as the observable factors to explain the behavior of the security returns; (2) fundamental factor model uses individual security attributes such as firm size, dividend yield, the book-to-market ratio, and industry classifications; (3) statistical factor model uses maximum-likelihood or principal-components-based factor loading analysis procedures on security returns to identify the factors in returns. The author reports the total and marginal explanatory power of each model. The results show that the fundamental and statistical factor models perform significantly better than the macroeconomic factor model. The fundamental factor model slightly outperforms the statistical factor model. However, the author notes that the macroeconomic factor model is superior with respect to its economic interpretability, and how to relate the security attributes used in fundamental factor model to the economic variables used in macroeconomic factor model may be a good area for future research.

Narayanaswamy (1996) compares the explanatory power of four models which employ two different approaches to correctly classify 85 stocks over the period 1961-1969 according to Farrell's (1974, 1975) classification schemes. The models that employ macroeconomic factor approaches include the five-factor model of Chen, Roll, and Ross (1986) and the two-factor model of Chen, Grundy, and Stambaugh (1990). The authors set up two models that employ the statistical factor approaches; one employs the principal component analysis and the other employs the maximum-likelihood factor analysis. The results show that five-factor model of Chen, Roll, and Ross outperforms the two-factor model of Chen, Grundy, and Stambaugh in identifying the stable and oil stocks return factors; as well as in classifying growth stock return factors; but is inferior in identifying cyclical stock return factors. On the other hand, both statistical factor models obtained from maximum likelihood factor analysis and principal component analysis are best in classifying the sample stocks.

Groenewold and Fraser (1997) compare the explanatory performance of APT that employs two different common approaches: macroeconomic and statistical factor approaches, and the CAPM. The authors use the monthly data of 19 sectors of stocks traded in Australian Stock Exchange over the period of December 1979 to April 1994. The results are consistent with the previous literature: the statistical factor approach outperforms the macroeconomic approach, and both versions of the APT clearly outperform the CAPM.

The early research on the APT focused on utilizing the statistical factor approach to find out how many factors should be included in the return generating function. However, a problem with this approach is that the factors extracted are merely statistical constructs that are not observable or identifiable with any single economic variable. Conway and Reinganum (1988) state that "at best, perhaps factor analysis can be used to confirm a prespecified factor structure. Economic theories should provide a better understanding of a meaningful factor structure than exploratory factor analysis. The current trend of prespecifying the factors seems to be a more promising avenue of research in the search for a stable and meaningful factor structure."

Chen, Roll and Ross (1986) conducts the first study by adopting the prespecified variable approach to identify the APT factors with macroeconomic interpretation on stock returns over the period of January 1953 to November 1982. The authors identify four priced factors which are unexpected changes in industrial production, unexpected inflation rate, risk premium measured by the difference in the yields between the low-Moody-grade corporate bond and high-Moody-grade corporate bond, and term premium measured by the difference in the yields between the long-term (10-year) Treasury bond and short-term (3-month) Treasury bill.

Burmeister and Wall (1986) regress several portfolio and individual share returns on four macroeconomic variables similar to those identified by Chen *et. al.* (1986) with introduction of an additional market factor. The results show that most portfolios and assets are significantly sensitive to these five factors. In addition, the authors find that the value of these sensitivities display significant variation across securities.

McElroy and Burmeister (1988) employ the iterated non-linear seemingly unrelated regression (ITNLSUR) technique to identify the factor sensitivity and risk premium jointly on monthly return data for a sample of 70 randomly selected securities over the period 1972-1982. The authors identify five variables similar to those identified by Chen *et. al.* (1986), and Burmeister and Wall (1986).

Groenewold and Fraser (1997) not only compare the explanatory power of the APT and CAPM, but also find that the factors priced in the data for Australian Stock Exchange are very similar to those found in other countries. Their model also contains inflation rates and interest rates as priced factors, which are common factors in the other APT models developed previously. Two monetary variables the 90-day bank-accepted bill rate and the rate of growth of M3 are found to be less common in the others, are also found to be the priced factors in their APT model for Australian dataset. The foreign influences such as the exchange rates or balance of payments are on the other hand surprisingly not to be significant for Australian dataset although Australia is an open economy.

So far as concerned, The Fama-French-three-factor model and the Carhart-four-factor model are the most famous and the most extensively employed model, which are used to evaluate an asset's excess return.

Fama and French (1993) apply a fundamental factor approach to model the generating factors in stock and bond returns. They use the time-series regression intercepts in cross-sectional regressions to determine how well the average risk factor premium explains the cross-section of average returns on stocks and bonds. They explore the relationship between these two markets and the variables important to the exploration of security returns. The authors use an approach that is different from that used in their prior work, Fama and French (1992). Fama and French (1992) use the cross-section regressions, in which the cross-section of stock returns is regressed on variables hypothesized to explain average returns. They recognize that, although the size and book-to-market may explain the variation in average returns across stocks, they cannot explain the large difference between average returns on stocks and those on Treasury bills. They state that it is difficult to add bonds to the cross-section regressions since the variables related to the equity characteristics such as size (price times number of shares) and book-to-market have no obvious meaning for bonds. They use the time-series regression approach in Fama and French (1993) where the explanatory variables are returns on a market stock portfolio and on mimicking portfolios for the prespecified return factors in this study.

The prespecified stock market factors are size and book-to-market ratio. The authors construct the portfolios by ranking the NYSE, Amex and NASDAQ stocks over the period 1963-1991 on the basis of size and book-to-market ratios. The stocks are ranked on size and the median size is then used to split the stocks into two groups: small (S) and big (B). The authors also rank the stocks on the basis of book-to-market ratios. The stocks are then divided into three groups: bottom 30% (Low, *L*), middle 40% (Medium, *M*), and top 30% (High, *H*). The intersections of the two size and the three book-to-market ratios groups yield the six portfolios, *S/L, S/M, S/H, B/L, B/M*, and *B/H.*

The first explanatory variable in stock-market factor time-series regression is *SMB* (small minus big). *SMB* is used to mimic the risk factor in returns related to size. It is the difference between the returns on small-stock portfolios (*S/L, S/M*, and *S/H*) and big-stock portfolios (*B/L, B/M,* and *B/H*). Any book-to-market effect is removed in the *SMB* since the book-to-market ratios are approximately equal between these two portfolios.

The second explanatory variable is *HML* (high minus low), which is used to mimic the risk factor in returns related to book-to-market (*B/M*) ratios. It is the difference between the returns on high-B/M portfolios (*S/H* and *B/H*) and low-B/M portfolios (*S/L* and *B/L*). This procedure gives a portfolio free of size effect.

The third explanatory variable is the proxy for the market factor in stock returns $\left(R_m - R_f\right)$, the excess market return, which is calculated as the difference between the return on the value-weighted portfolio of stocks in the six size and book-to-market portfolios $\left(R_m\right)$, and the one-month Treasury bill rate $\left(R_f\right)$.

The Fama-French three-factor time-series model of excess stock and bond returns on the stock-market factors is:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + s \cdot SMB_t + h \cdot HML_t + e_t \tag{2.1.3}$$

The authors have compared the ability of the one-factor model, which has the market factor as the explanatory variable only, and that of the three-factor model with all the three explanatory variables, in explaining the excess returns on stocks and bonds. They find that the three-factor model displays significant increases in adj. R^2 values in both stock and bond excess returns, which implies three-factor model has higher explanatory power.

The authors find that the three-stock-market-factor time-series regressions, where the dependent variable is the excess returns on stocks, provide relatively higher R^2 values. The authors state that the three-stock-market-factor model does a "good job" on the cross section of average stock returns, but they find misspecification for low book-to-market stocks. On the other hand, in the regressions where the dependent variable is the bond excess returns, the R^2 values are very low. It shows that the factors that explain stock-market return factors cannot explain the variation in the excess returns on bonds and implies the stock market return factors are restricted to explain excess stock market returns.

To strengthen the bond equation results, the authors specify two specific bond-market factors. The first explanatory variable is a measure of the term structure, *TERM*, which is the difference between the monthly long-term government bond return (*LTG*) and the one-month Treasury bill rate (*RF*) measured at the end of the previous month. The other explanatory variable is a proxy for default risk, *DEF*, which is measured as the difference between the return on a market portfolio of long-term corporate bonds (*CB*) and the long-term government bond return (*LTG*). The time-series regression model of excess stock and bond returns on the bond-market factors is:

$$R_{i,t} - R_{f,t} = \alpha + m \cdot TERM_t + d \cdot DEF_t + e_t \tag{2.1.4}$$

The estimation results are similar to that of the stock-market. The bond-market-factor regressions may provide a relatively higher R^2 values as the dependent variable is the bond excess returns. However, if the dependent variable is the stock excess returns, R^2 values are very low which also implies bond market factors may not capture variations in stock market returns.

The authors construct a regression model with the three stock-market factors and two term-structure factors as the explanatory variables. The five-factor time-series regression model is:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot [R_{m,t} - R_{f,t}] + s \cdot SMB_t + h \cdot HML_t + m \cdot TERM_t + d \cdot DET_t + e_t \tag{2.1.5}$$

The joint test where both stock- and bond-market factors are used to explain the stock and bond excess returns indicates that these two markets are linked through shared variation in the two term-structure factors. The high R^2 values indicate that the market factor $\left(R_m - R_f\right)$, *SMB, HML, TERM*, and *DEF* may proxy for common risk factors.

Fama and French (1995) extend their earlier work by studying the link between the behavior of stock prices and earnings. Fama and French (1993), indicated three systematic risk factors of return are related to asset pricing: book-to-market-equity (*BV/MV*) ratio (*HML*), firm size (*SMB*), and a market factor ($R_{m,t} - R_{f,t}$). In this study, the authors find that the market and firm size factors explain returns, but the link between returns and the book-to-market factor is very weak. The authors suspect their failure to find more systematic evidence that the returns are driven by these factors is due to noisy measurements of shocks to expected earnings.

Fama and French (1996) demonstrate that the three-factor risk-return relation, given by equation (2.1.3), adequately explains the returns on portfolios formed on size and book-to-market-equity. The authors find that the model also accounts for the strong patterns in returns observed when portfolios are formed on earnings/price, cash flow/price, and sales growth, which are the variables suggested by Lakonishok, Shleifer, and Vishny (1994). The model may capture the reversal of long-term returns documented by DeBondt and Thaler (1985); however, it cannot explain the short-term return persistence documented by Jegadeesh and Titman (1993).

The Fama-French three-factor model cannot capture the short-term return persistence documented by Jegadeesh and Titman (1993). As such, Carhart (1997) extends the Fama-French three-factor model to include additional factor that may capture one-year momentum anomaly. The Carhart's four-factor model is:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + s \cdot SMB_t + h \cdot HML_t + p \cdot PR1YR_t + e_t \qquad (2.1.6)$$

where $PR1YR_t$ is the one-year momentum (prior period performance) in stock returns.

The author finds that the four-factor model captures the considerable variation in returns. The results show relatively high variance of the *SMB, HML*, and *PR1YR* zero-investment portfolios and the correlations among them are low. This suggests that the model can explain sizeable time-series variation and the problem of multicollinearity do not substantially affect the estimated factor loadings.

Curcio, Kyaw, and Thornton Jr. (2003) question the effectiveness of the *SMB* and *HML* factors in Fama-French three-factor model. The authors select a sample of mutual fund data over the period 1995-2001. The results show negative regression coefficients of *SMB* [3] and *HML* for both one-year and three-year returns. These results may be interpreted as the large stocks invested outperform the small stocks and the low book-value (BV) stocks invested outperform the high BV stocks, which are the opposite of what one would expect, given the previous research.

The research on the number of factors in the APT model is still on going. Although many academics argue that the size and book-to-market cannot be interpreted as risk factors in the traditional sense, no one seems to question their importance in explaining stock returns. The Fama-French three-factor model remains the dominant model employed in studies on stock and mutual fund returns in the last decade.

2.2 Mutual fund performance

Numerous studies on fund performance relative to a benchmark have been undertaken in the last 30 years. The studies on fund performance employ the traditional Jensen measure (Jensen (1968)), Fama-French three-factor model (Fama and French (1993)), Grinblatt-Titman positive period weighting measure (Grinblatt and Titman (1989)), and Ferson-Schadt conditional Jensen measure that incorporates conditional information directly into the performance measure to control for the biases arising from fund managers responding to public information (Ferson and Schadt (1996)). Most of the results show that many funds underperformed the buy-and-hold strategy.

[3] The authors used *BMS* (Big Minus Small) and reported positive regression coefficients in their paper. To be consistent with other literatures reviewed here, *BMS* is changed to *SMB* and the sign of the coefficient is also reversed when reported here.

2.2.1 Empirical studies on equity fund performance

Sharpe (1966) develops a measure to evaluate mutual fund performance based on the reward-to-variability ratio (RV or Sharpe Ratio). Sharpe arises in favor of the RV Ratio as it captures the portion of variability due to lack of diversification in the portfolios of the funds. It takes the form:

$$\frac{R_{i,t} - R_{f,t}}{SD_i} \tag{2.2.1}$$

where $R_{i,t}$ is the rate of return of fund i at time t, $R_{f,t}$ is the riskless rate and SD_i is the standard deviation of rate of return of fund i.

Sharpe (1966) evaluates the performance of 34 open-ended mutual funds over the period 1954-1963 and underperformance of the funds relative to the benchmark is found as the average Sharpe Ratios of the sample funds which is smaller than that of the Dow-Jones Industrial Index and suggests that investing directly in diversified portfolios of securities may be a good investing strategy. Finally, ranking the sample funds reveal that good performance is associated with low expense ratios and large fund size.

To measure mutual fund performance, academic studies as well as professional mutual fund performance rating companies have employed performance measures that compare the returns of the portfolios of the mutual funds with the returns of a benchmark portfolio. The most widely one used in the academic literature, the Jensen Measure, is the intercept from a regression of the excess return of the fund on the excess return of a benchmark or market portfolio.

Jensen (1968) generalizes the CAPM to evaluate the performance of 115 mutual funds over the period 1945-1964 and finds that the funds on average were not able to outperform the market or a buy-and-hold strategy. The author's generalized CAPM as the following form:

$$R_{i,t} - R_{f,t} = \alpha + \beta\left(R_{m,t} - R_{f,t}\right) + e_t \tag{2.2.2}$$

where α is thereafter known as Jensen's measure that is used extensively to measure the fund's ability to outperform the market.

The results exhibit negative α that demonstrates the funds on average are not able to outperform the market, and the average value of β which is less than one, indicating that the fund managers hold securities less risky than the market portfolios. The frequency distribution of the α (intercepts) of all funds estimated on the basis of fund net returns and gross returns in the entire 20-year period, that of gross returns of 56 funds with data available for the entire period; and that of gross returns of all funds over the period 1955-1964, are all skewed to the low side with more than half number of funds having negative α's. The negatively skewed distributions in the gross returns demonstrate the funds on average do not perform well enough to recoup their brokerage expenses.

McDonald (1974) studies the relationship between the performance of 123 funds and their stated objectives, over the decade 1960-1969. The author first proves that the fund stated objectives may provide true information, as more aggressive funds truly have higher systematic risk and total variability. The empirical results show that the funds with "more aggressive" objectives demonstrate better performance measured by the Sharpe Ratio or Treynor Index. The regression model of returns against fund category (higher number indicates greater risk) also supports this finding, as the regression coefficient is significantly positive. Higher-risk funds appeared to produce better return to risk measures during the 1960's, which supports one of the CAPM assumptions that magnitude of expected return is positively associated with risk.

Compared with Jensen (1968), McDonald finds neither significantly "superior" nor "inferior" performance over the 60's. The author evaluates the overall performance of the funds in his sample with the market. The comparison of the sample funds versus the market shows that the sample funds have lower average beta but higher average total variability of returns. Approximately half of the funds have Treynor Index greater than the market and approximately half of the funds demonstrated positive estimates of Jensen's alphas. Only 5 percent of the funds have alphas significantly different from zero, however, only one-third of the funds had Sharpe Ratio higher than that of the market.

Chang and Lewellen (1985) use the procedure, which is derived from arbitrage pricing theory (APT) by Roll (1978) to test the performance of a sample of 67 equity funds over the decade 1971-1979 and document that funds in the 1970's also do not outperform the market. As a comparison, the authors also use a single-factor model to evaluate the performance of the funds. The authors define two figures that may be used as riskless interest rate – the T-Bill rate and the zero-beta (or zero-systematic-risk portfolio) return rate.

The empirical results show that the average estimated excess returns, measured by the intercept (α), are positive when the market-portfolios are value-weighted, but are negative when they are equal-weighted regardless of which riskless rate is used. However, there are more funds with significant negative alphas than those with significant positive alphas. They conclude that funds in the 1970's on average underperform the market.

Lehmann and Modest (1987) evaluate the performance of 130 mutual funds over the period 1968-1982 and test the sensitivity of the Jensen alpha and Treynor-Black Appraisal Ratio with the benchmark chosen. The authors show that most of the Jensen alphas and Treynor-Black Appraisal Ratio are negative regardless of what method used to construct the APT and the number of stocks used to construct the benchmark. This indicates that the mutual funds in the sample on average underperform the market regardless of which method used in constructing the APT model.

Grinblatt and Titman (1989) study the performance of 157 funds over the period from 1975 to 1984. The authors classify the funds by their investment objectives and document that the actual mutual fund returns on average do not demonstrate positive abnormal performance as measured by the Jensen alpha.

Grinblatt and Titman (1989) also study the effect of transaction cost on mutual fund performance by comparing the hypothetical returns and actual returns of the sample funds. The hypothetical returns are calculated by simulating the compositions of the equity portion of the funds' portfolios. Four benchmarks for the Jensen measures are tested: equally weighted (EW) and value-weighted (VW) stock indices, the Lehman-Modest (1988) 10-factor benchmark (F10), and the Grinblatt and Titman (1988) eight-portfolio benchmark (P8). The results show that transaction costs are approximately 1.5% larger than what is found in previous studies. The difference may be due to trading or other unspecified costs.

The authors classify the funds according to their investment objectives. With the P8 benchmark, the hypothetical returns of aggressive growth funds perform the best among all the groups tested. The F-test rejects the hypothesis that the performance for the different categories of funds is equal. A separate F-test indicates that the performance for individual funds within the aggressive growth and growth categories are different.

The authors also classify the funds according to their net asset values and find that fund size is inversely related to both hypothesized and actual returns, but, since the transaction costs estimated by the difference between the hypothetical and actual returns are also inversely related to the fund sizes, the actual net returns are unrelated to the fund sizes.

Coggin, Fabozzi, and Rahman (1993) document a sample of 71 U.S. equity pension funds over the period 1983-1990 that exhibits a positive stock selectivity measure (Jensen alpha measure) regardless of the choice of benchmark portfolios. This finding contrasts to previous studies on the performance of open-ended mutual funds. However, if the funds are classified according to their investment style, the results demonstrate that the stock selectivity measure is somewhat sensitive to the choice of the benchmark.

Malkiel (1995) argues the reported overperformance of funds during the 1980's is due to the inappropriate use of benchmarks. The author utilizes a unique data set of equity mutual funds over the period 1982 to 1991. The summary statistics of Jensen measure during the period 1971-1991 with Standard and Poor 500 Market Index return as the benchmark show that the funds have negative means.

Malkiel then estimates Jensen measures for the sample funds using the Wilshire 500 Stock Index and S&P 500 Index. The results show that using the Wilshire 500 Stock Index as a benchmark, the Jensen measure is negative when net returns are used but positive when gross returns are used. On the other hand, the Jensen measures are negative when either net returns or gross returns are used when S&P500 Index as benchmarks. Malkiel attributes the positive Jensen measure is due to the fact that Wilshire 500 Stock Index includes small stocks which are excluded in S&P 500 Index, and small stocks tended to underperform relative to the S&P 500 Index. The author concludes that inappropriate benchmarks, such as the Wilshire 500 Stock Index, are used to enhance reported results.

Cai, Chan, and Yamada (1997) provide the first comprehensive examination of the performance of Japanese open-type stock mutual funds for the 1981-1992 period. They document that regardless of the performance measures and benchmarks used; most of the Japanese mutual funds underperform. The authors use monthly data for 800 funds and 190 well-diversified Japan equity funds operated by nine fund companies. The statistics of the raw returns of the sample funds show that the funds on average underperform a value-weighted index using the stocks listed on Tokyo Stock Exchange (TSE), long-term government and corporate bonds, and convertible bonds.

The results of both one-factor unconditional and conditional Jensen measures reveal that the Japanese mutual funds underperform the market index. All eight different portfolios constructed by the authors exhibit negative alphas. The well-diversified Japanese equity fund performance is even worse. The histograms of both Jensen measures are skewed to the negative side. Further study splits the period into two covering the 1981 to 1989 bull market and the subsequent bear market from 1990 to 1992. The results demonstrate no difference in fund performance in either subperiod.

The Jensen measures for these nine individual companies during two subperiods show that even the best company underperforms relative to the market index. The three-factor model still generates negative alphas and the magnitudes are very close to those from the single-factor models. The conjecture that the single-factor Jensen measure may result in spurious underperformance measures due to managers tilted their portfolios toward large and well known firms is rejected.

Davis (2001) examines the relationship between performance and manager style using the Fama-French three-factor model for a sample of 4,686 equity mutual funds span from 1962 to 1998. The author constructs ten portfolios according to their slopes on the SML and HML factors in the first three years (1962-1964), or preformation period. The returns for these equally weighted portfolios were calculated for each month of 1965. The portfolios were then reformed each year. The results suggest that no portfolios constructed according to either *HML* or *SMB* style may earn abnormal returns during the 1965 – 1998 period.

Gruber (2001) studies the performance of a sample of 270 funds using a modified version of the Carhart (1997) four-factor model, which considers both the stock-market and bond-market factors:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + s \cdot SMB_t + h \cdot HML_t + m \cdot (R_{b,t} - R_{f,t}) + e_t \quad (2.2.3)$$

where $R_{b,t}$ is the return on the Lehman Brothers Aggregate Bond Index.

The author finds that the sample funds underperform the benchmark. The author splits the samples into surviving and non-surviving funds. As expected, the performance of non-surviving funds is much worse than the performance of surviving funds. The coefficients on the *SMB* and *HML* show that more aggressive funds give more weight to both the smallness and growth indexes. The less aggressive funds, on the other hand, have higher weighting on the income index exhibited by higher estimated coefficient on the excess return on bond index.

Drakos (2002) examines the performance of 77 mutual fund daily returns from January 1, 1997 through January 31, 2001, in the Greek market and documents that the sample funds outperform the market. The results of a single-factor model with the Athens Stock Exchange (ASE) index return as the benchmark, a two-factor model with ASE index return and S&P500 index return as the benchmarks, and a two-factor model with ASE index return and MSCI world index return as benchmarks, show positive Jensen alphas. The likelihood ratio test reveals that the two-index model with ASE and MSCI as benchmarks outperform the other two models, which also indicates the Greece mutual fund returns are driven by both domestic market conditions as well as the international conditions.

2.2.2 Empirical studies on Jensen measures conditional on public economic information

The unconditional models have one weakness in that superior fund performance may be incorrectly attributed to manager skill rather than abnormal performance and the use of public information. Ferson and Schadt (1996) is the first study to determine whether conditioning on public information has an impact on performance evaluation. The authors use five predetermined variables to proxy public information. These variables include: (1) the lagged level of the one-month Treasury bill yield, (2) the lagged dividend yield of the CRSP value-weighted New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) stock index, (3) a lagged measure of the slope of the term structure, (4) a lagged quality spread in the corporate bond market, and (5) a dummy variable for the month of January. The dataset that the authors use includes the monthly returns for 67 open-end mutual funds during the period 1968-1990. Ferson and Schadt (1996) find that the conditional models may remove the negative mutual fund alphas previously documented and shift the distribution of alphas right and centered to zero. Among the five predetermined public information variables, they found that the coefficients on lagged dividend yield of the CRSP value-weighted NYSE and AMEX index and lagged one-month Treasury bill yield are significant at 5% level. The authors suggest that when the covariance between the excess return on the market portfolio and conditional beta, $\mathrm{cov}(R_{m,t} - R_{f,t}, b_{2j}' Z_t)$, is negative, the traditional Jensen measure will be negatively biased.

Ferson and Warther (1996) discuss the rationale of using conditional measures. They agree that unconditional measures do not capture the fact that risk and expected returns may change with the state of the economy. For example, the unconditional Jensen model ignores the evidence that expected returns in the stock market are higher at the beginning of an economic recovery, when dividend yields are high and interest rates are low. This study replicates the conditional version of Jensen alpha as used in Ferson and Schadt (1996), to evaluate the performance of 63 open-end mutual funds during the period 1968-1990. They find that the conditional model may generate greater Jensen measures. They find evidence similar to Ferson and Schadt (1996) that the alphas become more positive when conditional model is employed. The empirical results show that two-thirds (66.7%) of all sample funds exhibit negative Jensen alphas, but that proportion is reduced to 52.4% where a conditional measure is employed. By using regression analysis, the authors find a significant negative relation between fund inflows and expected market returns, and significant positive relation between fund inflows and dividend yield. However, the relation between fund inflows and Treasury yield seems to be insignificant.

The two significant relations explain why the mutual fund managers tend to reduce market betas when public information implies relatively high expected market returns and raise them when expected returns are low.

Cai, Chan, Yamada (1997) results contrast to Ferson and Schadt (1996). The authors find that conditional Jensen measure cannot remove negative alphas in the Japanese mutual funds data. Instead, conditional Jensen measures shift the distribution of alphas left and make the average Jensen measures more negative.

Gregoriou (2003) uses the conditional approach as well as the traditional Jensen measure to evaluate the performance of funds of hedge funds (FOF) over the period 1993-2001. The author finds that the conditional version of the Jensen model provides a more accurate picture of the selection skills of FOF managers as the value of adjusted R^2 is higher in the conditional Jensen model.

Gregoriou (2004) replicates the conditional approach to evaluate the performance of the same dataset used in Gregoriou (2003). However, the author considered a range of public information variables in this study. They include: (1) the change in the corporate bond default-related yield spread; (2) the change in the term premium; and (3) the change in the intra-month implied volatility index of the S&P100 Index. The empirical results show that the conditional models are preferable to the unconditional models given higher values of adjusted R^2. The unconditional Jensen model indicates that the hedge fund managers have significant abnormal performance. The authors find strong evidence that the sample FOF exposure to market risk varies in response to the selected market indicators.

2.2.3 Empirical studies on index fund performance

Many empirical studies have found that active managed equity funds are unable to outperform passive benchmarks or indices such as the S&P500. By way of comparison, far fewer studies have considered the performance of passive managed equity index funds. Gruber (1996) examines the performance of US index funds during the period 1990 to 1994. The author employed the standard Jensen measure to evaluate the performance of index funds and finds that the funds underperform the target index by approximately

0.202% p.a. This leads the author to raise the question as to why individuals do not invest in passively managed index funds, which possess a relatively higher Jensen measure than the actively managed equity funds.

Pope and Yadav (1994) suggest that tracking error estimates are influential in managing index funds. The authors propose that two common approaches in statistics to find the value of tracking error may be employed to evaluate if the index funds are able to replicate the returns provided by their target indices. These two common approaches include using (1) the average of absolute difference in returns between the index fund portfolio and the underlying benchmark index return; and (2) month-to-month standard deviation of the difference in returns between the index fund portfolio and the underlying benchmark index return. That study uses the second definition of tracking error to evaluate the ability of the fund to replicate the target index. They find that the tracking error (3.98% p.a.) when using daily returns is twice that based on monthly returns (2.02% p.a.).

Frino and Gallagher (2001) extend Gruber (1996)'s research and study a sample of 42 US equity index funds during the period 1 March 1994 to 28 February 1999. They document that the sample index mutual funds underperform the target index by approximately 0.29% p.a. on an after-cost and risk-adjusted basis. Following Pope and Yadav (1994), the authors employ two common approaches to measure the tracking error. They find that the sample index funds do not replicate the returns of the benchmark indexes. This is mainly due to market frictions that do not have effect in the index which is calculated on the basis of holding a paper portfolio of index securities.

The authors also investigate the magnitude of tracking errors in every calendar month during the sample period. They find that the tracking error is significantly higher in the months of January and May. The hypothesis that the higher tracking error in May is due to the late receipt of dividend payments is accepted by the statistical evidence that the correlation between these two factors is positive and significant. The authors then hypothesize that the January effect is due to mutual fund flows that make the index fund managers rapidly engage in stocks trading by holding illiquid securities or even cash, to avoid cash drag. The authors also cite another reason for higher tracking error in January which is tax-related selling in December.

Frino and Gallagher (2002) replicate focus on the performance of Australian index funds ability to mimic the underlying All Ordinaries Accumulation Index. The authors replicate the two approaches that they have used in the previous study to compute the tracking error, which may be used to evaluate the performance of the index funds of Australia. The results confirm that the sample index funds indeed exhibit tracking error in their performance. The magnitude of the tracking error is comparatively higher than that found in the sample of U.S. index funds considered in (Frino and Gallagher (2001)). In Australian dataset, the tracking error ranges from 0.074% to 0.224% per month versus 0.039% to 0.110% in U.S. This comparison implies that the cost of trading the underlying portfolio of stocks in Australia and the management fees are higher.

Frino and Gallagher (2002) cite several causes of tracking error which are also found in the other studies (Chiang (1998)). These factors include transaction costs, index composition changes, corporate activity, fund cash flows, index volatility and the reinvestment of dividends. Frino and Gallagher use a regression model to investigate the relationship among the magnitude of tracking error and these factors. The regression analysis testing indicates that the tracking error is positively and significantly related to fund cash flows, the cost of trading stocks in the index portfolio and the volatility of the benchmark.

2.2.4 Empirical studies on influence of exchange rate risk

Some studies have noticed that the US-based international managed funds which trade in the foreign currency rather than the US dollar may offer an added bonus for US investors. For example, if the US dollar is weak relative to a foreign currency, the US investors who invest abroad may get an advantage as long as their holding fund does not hedge its currency exposure.

Madura and Wallace (1985) examine if the international portfolio performance are influenced by exchange rate fluctuations. The authors document that hedged international portfolios may outperform unhedged portfolios and that even partial hedging of portfolios may prove to be a preferable investment strategy. The authors find that for the case of Japanese stock market index, the volatility when hedged was less than half of the volatility when unhedged.

Lee (1987) finds evidence of low correlations between local bond returns and the local currency, which suggests that the local bond returns and currency returns are independent. The author thus focuses on these two elements in the process of building a multi-currency portfolio, an optimal asset portfolio and an optimal currency portfolio. The findings indicate that portfolios constructed on the basis of this separation outperform the portfolios which do not explicitly separate the asset and currency decision.

Bonser-Neal, Brauer, and Wheately (1990) examine if international investment restrictions may raise country fund price to net asset value ratios by segmenting international capital markets. The authors test whether the relation exists between announcements of changes in investment restrictions and changes in the ratios using weekly data from May 1981 to January 1989. They document that some country-specific funds trade at large premiums relative to their net asset values. The study provides evidence that some foreign markets are at least partially segmented from the US stock market.

2.3 Survivorship bias

There is a steady disappearance of mutual funds through merger, liquidation, and other means. As the investors have no interest on such funds, the performance of the nonsurvivors is usually not to be reported by mutual fund data services or financial periodicals, or purged from databases. The statistical data of the nonsurvivors *should* be available until the time of their exit. However, the data of these funds, when they were still survivors, appear to be put aside, or neglected. This imposes one selection bias to financial researchers: only survivors are included, namely the survivorship bias. Obviously, the funds disappear because their performance is very poor or their total market values are too small that management decides to merge them with the other funds provided by same fund house. The latter reason is always associated with the former reason: poor performance. Thus, this will make an upward bias in, or overestimate the performance of surviving funds. Thus, an investor, who is studying the mutual fund performance with unknowingly survivorship bias, may be given an inflated picture of these funds' past performance.

The survivorship bias affects every study of mutual funds. Almost all the databases include only the funds that are currently operating. Test methodologies often require funds that survive for a minimum time period to be included in the analysis. The survivorship bias may affect the test results, such as those generated in the cross-sectional regressions with performance as the independent variable. The use of survivor-only sample may seriously bias such regressions.

The correction for survivorship bias is also very important due to the following reasons. Firstly, the performance of mutual funds will be overestimated if the nonsurviving funds are excluded in the samples. Secondly, the survivorship bias impacts the return reported for mutual funds with different objectives, as funds with different objectives may have different level of attrition, or nonsurvivorship. Finally, some of the other variables studied may be correlated with nonsurvivorship and thus, studying a sample with survivorship bias may introduce spurious correlation between these variables and performance (Elton, Gruber, and Blake, 1996).

The current studies on survivorship bias are controversial for different aspects of funds, and different time periods. Some find significant overestimation in performance if non-surviving funds are not included in the samples, while some find insignificant result. Some studies have found the influences of survivorship bias on the performance persistence. Recent literatures on survivorship bias are not conclusive; some find that the biases are insignificant, while some find the bias of overestimation of returns of mutual fund dataset which exclude the non-surviving funds is significant. However, the finance researchers should be cautious in such bias especially when we are forced to use the survivor-only samples.

Grinblatt and Titman (1989) estimate the effect of survivorship bias when studying the quarterly mutual fund performance of all funds over the period 1975 to 1984. The survivorship bias is computed by taking the difference between the Jensen alphas estimated with the hypothetical returns from the bias-free samples of 274 funds and the Jensen alphas estimated with the hypothetical returns from the survivor-only samples of

157 funds. The authors find the positive bias in performance for samples of survivor-only funds is fairly small in buy-and-hold returns with averages range from 0.1% to 0.3% per year for different comparison benchmarks.

Brown, Goetzmann, Ibbotson, and Ross (1992) document that the survivorship bias is one of the sources of performance persistence of mutual fund winner. The authors find the evidence of performance persistence becomes more apparent if bad performing funds are truncated, shown by a larger average cross-product ratio that indicates the level of performance persistence if more worst-funds are truncated. They show that the high volatile losers perish and high volatile winners survive, exerting an upward bias on resulting performance persistence taken from survivor-biased samples. This finding is consistent with the traditional wisdom that funds that make risky bets will either show relatively high returns or fail to survive. Thus, high returns will tend to persist.

Brown *et. al.* also find the magnitude of the performance persistence is determined by the selection rule. They find if the mutual funds have equal variances and the selection process removes funds with low two-year returns, the persistence are downwardly biased. The authors conclude that the survivorship bias is a function of dispersion in mutual fund volatility and the selection rule.

Hendricks, Patel, and Zeckhauser (1993) study the effect of survivorship bias when they study the performance persistence of 165 mutual funds over the period 1974 to 1984. The authors find the survivorship bias does not affect the evidences of performance persistence much. The authors determine the evidence of performance persistence of their samples which include non-surviving funds and other perform identical performance persistence study using a different dataset which is based on 130 equity mutual funds over the period 1968 to 1982 but are still operating at the end of 1982. This dataset has been used by Henriksson (1984), Lehmann and Modest (1987), and Connor and Korajczyk (1991). The results show that the regression results that are being used to evaluate performance persistence are quite similar in both datasets. The authors conclude that the survivorship bias is unimportant for studying persistence in mutual fund performance.

The later studies on survivorship bias made a different conclusion that the survivorship bias is not so insignificant and such bias should be corrected in the studies of mutual funds. The major reason is that the studies done after 90's include the data on 1987, when there was stock market crash that made some mutual funds ceased operations.

Blake, Elton, and Gruber (1993) document the existence of survivorship bias in the dataset of bond funds. They estimate the survivorship bias by taking the difference in three-factor alpha measures between the funds that survive and those that don't survive. They estimate that the survivorship bias raises the return by 0.27% per year.

Brown and Goetzmann (1995) document smaller funds have higher probability to cease operations. The authors use the data from *Mutual Fund Panorama,* provided by the Weisenberger Investment Companies Service, for the period over 1976-1988. They compare the returns of the funds in the entire sample and those of the funds that were still operating in 1988. They find that the latter is overestimated by 0.8%. When the returns are scaled by capitalization, however, the difference is 0.2% only. The result is consistent with the circumstances that larger funds to have a higher probability of survival.

Malkiel (1995) argues that two common practices of large mutual fund complexes will create survivorship bias in mutual fund datasets. The first is the tendency to merge the fund into one of more successful funds in the complex. The other is the start of a set of experimental funds ("incubator" funds) where the unsuccessful funds are dropped after a test period. Both policies tend to catalyst the survivorship bias problems. Malkiel finds the survivorship bias overestimate the mutual fund returns significantly in the mutual fund datasets provided by Lipper Analytic Services during the 21-year period 1971-1991. The author estimates the dollar-weighted average return for all funds in existence each year and that for the funds in existence in 1982 that survived through 1994. The results indicate that the average returns for the surviving funds are significantly higher than those for all funds. The average returns for all general equity mutual funds in existence over the study period is 15.69%; however, the average return for the funds in existence in 1982 that survived through 1994 is 17.09%.

Malkiel cuts the data annually and calculates the annual average returns for all funds in existence, those for the funds surviving until 1992 and those for the funds that do not survive until 1992. The author finds that the annual average returns for the surviving funds are significantly higher than those for the non-surviving funds throughout the study period. The statistical tests, t-test for testing difference between annual average returns of surviving funds and non-surviving funds, are performed on these annual differences and the results indicate that the differences are significant.

Elton, Gruber, and Blake (1996) perform a comprehensive study on survivorship bias of mutual funds that exist at the end of 1976. This study analyzes several issues related to survivorship bias. The authors estimate the survivorship bias by estimating the difference in Fama-French three-factor alpha measure between funds that survive and those didn't survive at the end of 1976. For a comparison, the authors also estimate the survivorship bias based on Jensen single-factor alpha measure and raw returns. They find that the survivorship bias raises the Fama-French three-factor alpha measure, Jensen one-factor alpha measure, and the raw return by 0.9069%, 0.3199%, and 1.8743% respectively. The authors then calculate the above performance measures taking into account the merger terms namely the "follow the money" approach, which assumes that for funds that merge into another funds, the investors continue to hold the new fund. The result shows that the survivorship bias raises the above performance measures by 0.7716%, 0.7716%, and 0.7301% respectively; the result shows that the estimate of bias remains unchanged. The authors thus conclude that the "follow the money" approach has the advantage of being more robust to different metrics for performance measurement.

Elton *et. al.* also determine the survivorship bias over different horizons. They find that the survivorship bias in Fama-French three-factor alpha measure becomes larger as the horizons are longer. They also find that the survivorship bias in different time horizons is smaller if the "follow the money" assumption has been made. For comparison, the authors have done an identical analysis for Jensen single-factor alpha measure and find a similar result.

Finally, Elton *et. al.* document the survivorship bias will lead to incorrect inferences about the impact of two fund characteristics: fund size and investment objective. Regarding the fund size, the authors show that if survivorship-biased samples are used, there will be no difference in performance measured by Fama-French three-factor alpha measure between the large funds and the small funds. However, the small funds have a negative Fama-French three-factor alpha more than twice the negative Fama-French three-factor alpha measures of the large funds if the samples are free of survivorship bias. Regarding the investment objective, the funds with maximum capital gain objective, and those with growth objective have positive Fama-French three-factor alpha measures if the samples are survivorship-biased. However, if the survivorship bias is corrected, all fund categories: maximum capital gain, growth, and growth & income have negative Fama-French three-factor alpha measures.

Carhart (1997) find significant survivorship bias which affects the pattern of performance persistence when he studies the performance persistence of equity funds over the period 1962 to 1993. Carhart finds that the performance measures will be biased upward by 1% per year if only surviving funds are included in the samples. Regarding the impact of survivorship bias on performance persistence, the author shows that the full survivor-free sample displays the strongest performance persistence; the survivor-biased sample, on the other hand, displays the weakest performance persistence.

Hendricks, Patel, and Zeckhauser (1997) find an interesting influence of survivorship bias on performance persistence if the funds are sorted into eight groups rather than two groups, superior and inferior performers only. They sort the survivorship-biased funds into merely two groups in their previous study (Hendricks *et. al.* (1993)), which finds strong performance persistence in monotonic pattern. However, they find the survivorship-biased samples generate a distinctive J-shape relationship between two-period performances if the funds are sorted into eight groups.

Volkman (1999) shows the survivorship bias may be removed by randomly selecting funds at the beginning of the sample period. It is because the funds that do not survive over the sample period will not be excluded from the empirical analysis.

Brown, Goetzmann, and Ibbotson (1999) is the first study to estimate the survivorship bias in the annual returns of offshore hedge funds listed in the 1989 through 1995 issues of the *U.S. Offshore Funds Directory*. The authors find that the returns of their portfolios including all surviving and non-surviving funds averaged 13.3% per year. However, the average historical return presented by the *Directory* is 16.3%. Such difference exhibits the survivorship bias is 3% per year.

Fung and Hsieh (2000) extend Brown *et. al.* (1999) study on the survivorship bias in hedge fund database over the period 1994-1998. Fung and Hsieh employ the TASS Investment Research's database, which contains 1,120 surviving and 602 non-surviving funds, as at September 1999. The authors find that the surviving funds have an average return of 13.2%, while the portfolio containing all surviving and nonsurviving funds has an average of 10.2%. The survivorship bias may then be inferred as 3% per year, which is similar to Brown *et. al.* (1999).

Consistent with Elton *et. al.* (1996), Carhart, Carpenter, Lynch, and Musto (2002) find that the survivorship bias increases with the sample length in a comprehensive study on survivorship bias using the same mutual fund data of Carhart (1997), which covers all known diversified equity funds monthly over the period from January 1962 to December 1995. The survivorship bias increases from 0.07% for one-year sample, to larger than 1% for samples longer than 15 years.

Carhart *et al.* show the survivorship bias influences the relationship between performance and key operating characteristics, including the fund size, expenses, turnover, and load fees. The authors set up several simple and multiple regression models in which the dependent variable is performance, the explanatory variables are the fund characteristics mentioned above. They find that if full sample rather than survivor-only sample is used, the relationship between the performance and the expenses changes from insignificant negative to significant negative, and that between the performance and the fund size even changes from negative to significant positive.

The researchers should be cautious on the impact of the survivorship bias when we are forced to use the survivor-only samples. It seems that finance researchers are always in this position. The survivorship bias appears in not only the mutual fund studies but also the empirical market studies. Goetzmann and Jorion (1999) document that how the equity market disappearance cause the downward drift in performance over time.

2.4 Return persistence

While the efficient market hypothesis has caught attention among academics in testing if funds exhibit superior performance in the early 90's, there was little research to test the existence of fund return persistence. As the firms that are devoted to measure the mutual fund performance is based on the idea that funds that do well (or poorly) in the past will continue to do so in the future and the investors indicate the past performance of the fund should be the primary factor in choosing a fund, the arguments of the existence of return persistence are raised among the academics. A large and growing number of recent empirical studies document if the mutual fund returns exhibit persistence in these years. Studies of performance persistence fall into two camps: those that do not find persistence and those that do. More evidences of persistence in mutual fund returns are found in the decade of 90s compared with the prior two decades.

The methods that may be employed to find performance persistence consist of two streams: parametric method and nonparametric method. Parametric method which refers to a regression of the current period performance on that in the preceding period has been widely use before. A conclusion of performance persistence will be made if there is a significant regression coefficient. Nonparametric method involves constructing the contingency tables, in which the funds are divided as winners and losers based on certain benchmark. The Chi-square independence test is sometimes done to evaluate the significance of the result.

Carlson (1970) documents evidences of persistence in mean return ranking and risk ranking, but no evidence of persistence in risk-adjusted performance ranking of 57 funds over the period 1948 to 1967. The author finds that the mean return rankings and risk rankings in the first decade (1948 to 1957) are good predictors of those during the second decade (1958 to 1967). The evidence of persistence in the rankings based on the risk-adjusted performance, on the other hand, does not exist but there is a slight tendency that the funds remain in the top or bottom quartiles during both decades. To have a deep exploration of this slight tendency, the author breaks down the 20-year period under study into 11 overlapping 5-year periods. Greater level of consistency in 5-year risk-adjusted return ranks is found.

Elton, Gruber and Rentzler (1990) find evidences of persistence in monthly returns on all publicly offered commodity funds listed in the MAR reports over the period 1980-1988. In this study, the authors switch to a calendar year for analysis as there were more data. The authors find that the funds managed by managers with above-average prior experience outperformed those managed by managers with below-average prior experience.

Grinblatt and Titman (1992) document return persistences of 279 mutual fund and 109 passive portfolios constructed from the CRSP daily returns over the period 1974-1984. The passive portfolios are constructed to test the reliability of the result. The mutual fund performance persistence is analyzed in the following procedure. Firstly, the fund returns are divided into two five-year subperiods. Secondly, the abnormal returns of each fund for each subperiod are computed relative to the eight-portfolio benchmark, P8. Such performance measure is an extension of the new benchmark used in their previous study (Grinblatt and Titman (1989)). The P8 benchmark consists of four size-based portfolios, three dividend-yield-based portfolios, and the lowest size-based portfolios. This benchmark was developed to remove the biases of small-firm effect and high dividend effect. Grinblatt and Titman (1989) show the P8 benchmark is a superior benchmark. The intercept (α) in the regression model of excess mutual fund returns on excess returns of the P8 benchmark will serve as the abnormal returns. Finally, the slope coefficient in a cross-sectional regression of abnormal returns from 1979 to 1984 on those computed from the previous five years (1974 to 1979) is estimated. A significant regression coefficient would reject the null hypothesis that there is no relation between the past performance and the current performance. The results show the regression coefficient is significant positive, which present an evidence of persistence in performance of sample mutual funds. The regression coefficient that is used to evaluate performance persistence of managed funds is on the other hand insignificant. This result shows that the past performance of actively managed mutual fund is useful information for an investor as a criterion to select a fund.

Hendricks, Patel and Zeckhauser (1993) document the “hot hands” effect in short-term predicted returns, i.e. short-run persistence of relative performance of 165 no-load, growth, equity funds over the period 1974-1988. The samples are restricted to no-load funds to make the switching costs be zero, which is convenient to study the switching strategy. To have funds with homogeneous strategies and institutional characteristics, the authors also restrict the samples to growth funds. Hendricks, Patel, and Zeckhauser desire to test the ability of short-term returns-to-reliability to predict a fund's return rank. Therefore, they focus on one-year persistence, which time interval is shorter than that used by Grinblatt and Titman (1992). The authors find that the hot-hand strategy, which of selecting the top performers (i.e. top octile in excess return, which is calculated by Jensen measure) based on the last one-year significantly outperform the average mutual fund. The authors find the same short-run persistence in fund excess returns relative to P8 benchmark, which shows the hot hand phenomenon is not driven by already known anomalies.

Blake, Elton, and Gruber (1993) document insignificant evidence of performance persistence of 46 sample bond funds over the period 1979-1988, by seeing if the four best performing funds in the first 5-year subperiod still outperform the worst four funds in the subsequent 5-year subperiod. The six single-factor, three-factor, and six-factor regression models are employed to measure the performance. The results show that on average the best performing funds continued to outperform the worst. However, the persistence is not obvious as the magnitude of the difference is small. Two regression models even yield controversial conclusion that worst performing funds outperform the best in the subsequent subperiod.

Grinblatt and Titman (1993) document the evidence of persistence in performance measured by Portfolio Change Measure (PCM) of 174 mutual funds over the period 1975-1984. Same to Blake, Elton, and Gruber (1993), the persistence is examined by observing if the best funds in the first 5-year subperiod still outperform the worst funds in the subsequent 5-year subperiod. The results indicate the existence of persistence as the best funds in the first 5-year still exhibit higher PCM than the worst funds during the subsequent 5-year subperiod. If the funds are classified into several groups according to their investment objectives, the evidence of persistence is weaker but the aggressive-growth category still exhibit significant evidence of persistence.

Goetzmann and Peles (1994) explain the herding towards fund performance through a phenomenon called cognitive dissonance, where individuals alter their perspective to justify their purchases. The authors used a questionnaire, distributed to educated investors and casual investors, and found that both groups exhibited a positive bias when asked about fund performance. They conclude that this positive bias may partly explain why both investor groups continued to contribute to poor performing funds.

The two-way cross-tabulation table developed by Goetzmann and Ibbotson (1994) is used extensively in the later performance persistence studies. Such method is classified as nonparametric method.

Goetzmann and Ibbotson (1994) use a two-way cross tabulation that is fresh in academics at that time, instead of cross-sectional regression, to investigate the persistence in monthly returns of 258 funds over the period 1976-1988. The authors have investigated the persistences of raw returns, and risk-adjusted returns measured by Jensen alpha measure. Two-way cross-tabulation tables are set up to investigate the persistences of raw returns and risk-adjusted returns over successive two-year and one-year intervals. The authors defined the winners as the funds which returns are higher than the median fund returns.

Persistence analysis using two-way tables over successive two-year intervals shows evidence of persistence in both raw returns and Jensen measures in most of the years except that the raw returns showing reversal between 1980-1981 and 1982-1983. The authors hypothesize that the reversal is due to the relative performance driven by common responses to some phenomenon that varies with time. The authors query if the tests using raw returns that are not adjusted for risk may document merely the differential expected returns between high-risk versus low-risk funds. The analyses of the persistence of Jensen measures further document the evidence of persistence. Adjusting for risk improves consistency because there is no exception in five of the two-year intervals. Besides the two-way tables, some regression models are also set up to detect the magnitude of the two-year alphas on the subsequent two-year alphas. The results are significant in four out of the five periods, and are extremely significant for the combined regression results.

Identical persistence tests using two-way tables are done on the growth funds to test whether the repeat-winner phenomenon is due to varying mixtures of stock and bonds or related more to style than skills. Similar results are found in both raw-return-persistence test and Jensen-measure-persistence test; therefore, the authors' hypothesis is not supported.

The successive one-year persistence tests for raw returns support the evidence of performance persistence. Besides finding the evidence of persistence in all sample funds, the authors separate the funds into high-variance funds and low-variance funds to detect if the survivorship bias is exacerbated by different fund volatilities. The funds are categorized as high-variance if the variances of the funds are above the median, while median and below funds are categorized as low-variance funds. The result shows that the phenomenon of persistence is stronger in high-variance funds, indicating the survivorship is a possible source of bias in the performance study.

The authors explicitly increase the number of time-series-dependent observations by using monthly rankings. The documentation of persistence in monthly returns using regression of monthly relative performance (i.e. rank) on preceding monthly relative performance also provides the evidence of persistence. The authors have set up two regression models, one using the raw return ranks, and another using the Jensen-measure ranks. The regression coefficients of both models are positive and the t-statistics show that these two coefficients are extremely significant. The results support the evidences of performance persistence in monthly returns also.

Malkiel (1995) reports temporal differences in return persistence. The dataset contains quarterly returns over the period 1971 to 1991. Using two-way cross tabulation, the author finds significant performance persistence during the 1970s. The evidence of persistence becomes weaker during the 1980s. The percentage of winning funds tending to repeat their winning performance reduces from 65.1% to 51.7%. The author also finds return reversals for the years 1980 and 1987, which is consistent with Brown and Goetzmann (1995). Besides these two years, the author finds two additional reversals in 1988 and 1990.

Brown and Goetzmann (1995) explore the persistence in annual fund performance over the period 1976-1988 and also find return reversals for the years 1980 and 1987. Following Brown *et. al.* (1992) and Goetzmann and Ibbotson (1994) approaches, two-way tables are set up to test the performance persistence. Evidence of significant persistences in seven or eight periods out of twelve years is found. Negative persistence is found in two years, 1980 and 1987. This finding is consistent with Malkiel (1995), who finds reversals in the years following 1987 and the period over the late 1970s and early 1980s.

Brown and Goetzmann hypothesize the secular trend in performance persistence is due to the difference between the systematic risks across managers. Single-factor and three-factor alpha measures are employed to measure the excess returns. The results show that the R-squared values of both models are higher than 0.9, which indicates using single-factor or three-factor models to adjust for risk does not affect the persistence patterns. Identical tests of performance persistence are performed for raw returns and risk-adjusted returns using various benchmarks. The similar cross-product ratios and Z-statistics results in the tests using raw returns and risk-adjusted returns indicate the persistence is due to repeat loser funds.

Kahn and Rudd (1995) is the first study documents the evidence of persistence in performance that is measured by information ratio. Besides, the authors also investigate the persistence in total returns and selection returns. The samples include 300 equity funds over the period January 1983 through December 1993, and 195 fixed-income funds that are domestic bond funds over the period October 1988 through September 1993. The authors use regression analysis to investigate the persistence. Following Goetzmann and Ibbotson (1994), the authors also use two-way contingency tables, but they supplement the tables with homogeneity test which results in a test statistic χ^2 to test if the numbers of funds in the diagonal bins (winner-winner and loser-loser) are significantly higher.

Regarding the samples of equity funds, Kahn and Rudd find the evidence of performance persistence when performance is defined as information ratios and regression models are employed to examine the persistence. No evidence of persistence, on the other hand, is found in different measures if two-way contingency tables are used. In contrast to the results for equity funds, the evidence of persistence may be found in fixed-income fund selection returns and information ratios when regression analysis is used. When contingency table approach is used, once again, the fixed-income selection returns and information ratios exhibit persistence of performance.

Gruber (1996) documents the existence of persistence in raw returns, single- and four-factor alpha measures, of 270 funds over the period 1985-1995. The author ranks the funds and places them into deciles on the basis of past returns. The statistical significance of the performance persistence test is evaluated in two ways: (1) a rank correlation of the deciles in adjacent periods, and (2) a test of the differences in mean decile returns. The results reveal the existence of persistence in performance regardless of which measure. Among them, the four-factor alpha measure is superior in predicting future performance compared with the other measures. Persistence is found in both one-year and three-year holding periods. In the subsequent section of that study, the author shows that investors recognize the existence of superior management ability and act rationally when purchasing actively managed equity mutual funds.

Ferson and Schadt (1996) apply conditional alpha measures to evaluate fund performance and document evidence of performance persistence in monthly equity fund returns for the period over 1968-1990. The authors find that the correlation coefficients which show the significance of persistence between two successive periods regardless of traditional or conditional alpha measure reduce significantly as the top and bottom 10 percent performing funds are dropped from the sample. The authors state the return persistence may be due to the extreme performance of some funds.

Elton, Gruber and Blake (1996) document the predictive ability of future risk-adjusted performance of 188 "common stock" funds with assets greater than \$15 million over the period 1977-1993. The authors rank the funds into deciles on the basis of total return, 3-year alpha, and 1-year alpha. The authors find that the past performance may provide information about the future. The funds in top deciles, regardless of which performance measure, may provide higher 1-, and 3-year alpha measures. Furthermore, the authors find that when the current performance is evaluated over a 1-year period, selection of funds based on the prior year's data conveys much more information about the current performance than using the prior 3-year performance data. On the other hand, if the current performance is evaluated over a 3-year period, selection on prior 3-year Jensen measure conveys more information. The authors find not only "hot hands" phenomenon but also the evidence of longer persistence in performance than noted in the other literatures prior to this one. Finally, the authors find the evidence that the bad performance of the lowest decile funds is largely due to high expenses and they find that the persistence evidence does not exist in the lowest deciles.

Cai, Chan, and Yamada (1997) document insignificant persistence in the performance of 800 Japanese equity funds operated by nine Japanese fund companies over the period 1981-1992. The authors rank the nine fund companies according to their unconditional and conditional Jensen single-factor alpha measure across two subperiods: one is during the bull market 1981 to 1989, and the subsequent subperiod during the bear market 1990 to 1992. Spearman rank correlation is employed to examine the persistence in the ranks. The results exhibit positive correlation coefficient not significantly different from zero and the conclusion that there is insignificant persistence in performance among nine companies may be drawn.

Carhart (1997) argues that many earlier findings on the performance of funds were largely driven by "momentum effect" in the stockholdings of the funds. Carhart's (1997) study is an important, comprehensive and widely cited contribution to the literature. The author documents insignificant evidence of persistence among top-performing funds; while, in contrast, underperforming funds are found to persist their performance. The authors investigate the persistence in performance measured by Carhart's four-factor alpha measure shown in equation (2.1.6) of 1,892 diversified equity mutual funds for the period 1961-1993. Carhart replicates the methodology of Hendricks, Patel, and Zeckhauser (1993) to examine the persistence in decile fund portfolios based on one-year lagged returns. The author finds that reported past returns, net of operating and transaction expenses, contain valuable information for the subsequent years' returns. The author reports buying last year's top-decile mutual funds and selling last-year's bottom-decile funds yields a return of 8 percent per year. Standard deviations of the top-decile funds and bottom-decile funds are almost the same, indicating that the variance of the returns does not explain the spread in returns. With CAPM, the author finds that the beta, with is the primary criterion for this model, is the same for all sample funds; that indicates beta does not explain the variance of the returns.

Carhart further examines whether momentum strategy funds do consistently outperform, he ranks all funds by their loading on the additional variable in Carhart four-factor alpha measure model, *PR1YR*. In the post-ranking period, the funds with the best one-year momentum are found to underperform rather than outperform, as measured by Carhart four-factor alpha.

Carhart attempts to explain the remaining return persistence with a cross-sectional regression analysis of key operating characteristics, including expense ratio, modified turnover ratio, total net assets (TNA), maximum load, and two explanatory variables from turnover to separate the effects of buying and selling trading. The results show that the lowest return decile funds tend to have higher expense ratios, and turnover ratios. The phenomenon that the funds with higher expense ratios underperform is consistent with the findings in Elton, Gruber and Blake (1996). Thus, expense ratios may have some power to explain performance persistence. Turnover does not provide any additional information. Total net asset growth patterns highlight an asymmetric investor response to past performance. Investors move into the top performing funds at a faster rate than they liquidate shares of losing funds. Carhart hypothesizes that transaction costs may explain the persistence of the lowest return decile. Some prior studies demonstrate that turnover ratios are similar for the high and low return funds; therefore, transaction effect should be linked to cost per transaction instead of total volume of transactions. Additional regression analysis indicate that lower rank portfolios have higher costs per transaction due to higher brokerage cost and higher costs from trading low liquidity stocks.

Carhart tests whether the mutual funds within the ranked portfolios are consistent through time. Tests show a lack of consistency in fund rankings across adjacent periods. The results demonstrate that the funds in the top decile differ each year. In other words, the adjacent-year rankings on most funds are random. Additional tests with portfolios sorted on lagged two, three, four, and five-year simple returns show similar return patterns. However, the tests with one-year past returns generate the largest spread in mean return. Thus, Carhart confirms the Hendricks, Patel and Zeckhauser's (1993) "hot hands" result is mostly driven by the one-year momentum effect of Jegadeesh and Titman (1993).

Carhart explains the return patterns with sensitivity to common factors and fund expense ratios. The 8% annual difference in return between the highest and lowest return decile portfolios is reduced 2.6% to 4.4% per year following adjustment for size, book-to-market equity, and one-year momentum factors. The author explains this 8% difference may be explained as follows: 5% is due to differing size and momentum of the stocks held by the funds, 1% is due to expense ratio differences, and 1% is because of transaction cost differences. The unexplained return persistence is concentrated in the lowest performing decile of funds.

Conclusively, this study suggests the followings: (1) the investors should avoid buying the lowest performing decile funds, in other words, with persistently poor performance; (2) well performing fund this year have above average expected returns next year, but not in years thereafter; and (3) most of the gains are consumed by fund expenses and transaction costs.

Bers (1998) document the existence of performance persistence in a sample of 101 U.S. registered international mutual funds over the period January 1990 to March 1996 by using both parametric regression analysis and nonparametric two-way probability table. The author employs four different measures to evaluate the performance of the funds, including risk-unadjusted returns, Jensen alpha, Sharpe Ratio, and Treynor Ratio. The results are quite consistent that the evidence of performance persistence is stronger than the evidence of performance reversal, regardless of which stream of methodology is used and which measure of performance is employed. Within this six-year sample period, 1991 to 1992 shows higher level of performance persistence; while 1993 to 1994 on the other hand shows higher level of performance reversal.

Cheng, Pi, and Wort (1999) document no significant evidence of performance persistence in mutual funds managed by Hong Kong fund houses during the period 1992 – 1996. The authors take a different prospective to explore the persistence in mutual fund performance. They examine the performance of fund houses as a whole instead of individual funds' returns. This study contributes to the current literature on the relationship of common management strategies and supervision to fund house performance persistence. They find only two fund houses out of thirty-two exhibit significant persistence, which contradict most pervious studies on American mutual funds that found significant short-term persistence. The authors also explore the relationship between the persistence of fund houses' performance and economic significance by correlation analysis. They find that there is no significant association between these two aspects and may conclude that the investors may not earn significant excess returns from investing in hot hand houses. On the other hand, there is significant positive association between the persistence of fund houses' performance and performance of individual funds provided by these fund houses. This shows that the hot hand fund houses typically have more well performing funds, which supports the view that some common management strategies and supervision may be the underlying causes of short-term persistence.

Quigley and Sinquefield (1999) document that the UK unit trusts funds exhibit performance persistence. The authors form 10 equally-weighted portfolios of unit trusts on the basis of decile rankings of the funds' raw returns over the previous 12 months. This forming method is repeated every year, giving a time series of returns for each decile. The result shows significant spread in the annual compound return between the best and the worst decile. However, when the performance are adjusted for risk by Fama-French three-factor model, the alphas of the 10 decile portfolios do not suggest any significant persistence in performance. Among the 10 post-formation decile portfolios, only the bottom two consistently produces significant negative alphas during the sample period. This leads to the conclusion that poor performance persists but good performance does not. In addition, the investigation of the duration of performance persistence indicates that any pattern of persistence has almost entirely disappeared after three years.

Blake and Timmermann (1998) document that the UK unit trusts exhibit significant performance persistence in both top- and bottom-performing trusts after the performance are risk-adjusted. Blake and Timmermann restrict the samples to be 855 funds investing in UK equity over the period February 1972 to June 1995. The authors form two equal-weighted portfolios of funds from among the top and bottom quartiles on the basis of historic alpha over the previous 24 months and hold these portfolios for only one month. They carry out this procedure separately for funds investing in five sectors: equity growth, equity income, general equity, smaller companies and a balanced sector. Similar to the findings by Quigley and Sinquefield (1999), the bottom-performing portfolios consistently produce significant negative abnormal returns over the sample period. On the other hand, with the exception of the balanced sector, the top-performing portfolios consistently show significant positive abnormal returns, which is in sharp contrast to the findings by Quigley and Sinquefield (1999). The major differences between these two studies are different measures of abnormal or risk-adjusted return, and different frequencies of rebalancing.

Allen and Tan (1999) find similar result that the UK unit trusts exhibit performance persistence. They document evidence of return persistence of 131 U.K. managed fund over the period 1989 and 1995. The authors query assessing persistence through a recursive portfolio formation scheme in Quigley and Sinquefield (1999) aggregates the data considerably rather than looking at persistence at individual fund level. Allen and Tan investigate the persistence in performance measured by raw return and risk-adjusted returns of individual unit trusts by employing two common parametric and nonparametric methods. The results show that long term (one- and two-year-intervals) raw returns and alphas exhibit significant evidence of persistence. On the other hand, this evidence appears to reverse in the short-term (semi-annually and monthly). In addition, the relation between the volatility and the persistence is studied by classifying the funds as high-variance and low-variance. The performance measured in alphas and raw returns still exhibit repeat-winner patterns in two different classes of funds.

Agarwal and Naik (2000) document evidence of persistence in the sample of 746 quarterly, 716 semi-annually, and 586 annually hedge fund performance over the period 1982-1998, by both parametric and nonparametric tests. The authors find consistent results using both tests for pre-fee and post-fee returns. The results show that the evidence of persistence is the strongest at the quarterly horizon and reduces as the horizon is increased, which is in contrast to the findings in most traditional mutual fund studies. In addition, the evidence of persistence is not related to the type of strategy employed by the funds. Both non-directional and directional strategy funds exhibit similar patterns of persistence. The authors employ not only the successive two-period framework but also multi-period framework. The authors employ the two-sample Kolmogrov-Smirnov (K-S) test to check if the observed frequency distribution is statistically different from the hypothesized distributions, one is without making any distributional assumptions and the other is normal distribution. The results of the K-S tests provide consistent conclusion of three interesting features: (1) the extent of persistence decreases as the return measurement interval (the time horizon) increases; (2) Some persistence seems to be driven more by losers than by winners; and (3) the level of persistence is smaller in the multi-period framework and the persistence even does not exist at the annually return horizon at 10% level.

Philpot, Hearth, and Rimbey (2000) document a very modest short-run persistence in the high-yield bond funds subsample among a sample of 73 nonconventional bond funds, which include high-yield bonds, global issues, and convertible bond funds, over the period 1988-1997. The authors employ one nonparametric test, goodness-of-fit test, to study the performance persistence. The authors assume that if the performance persistence does not exist, the mutual fund's ranking in one period should be independent to its ranking in the prior period. In other words, a fund in one quintile rank in one period should be equally likely to be in any quintile in the following period. A χ^2 test is then employed to test the hypothesis of the existence of uniform distribution in the two-way cross-tabulation. The results reveal that the subsample of global issues and convertible bond funds seem to have a more likely uniform distribution than the subsample of high-yield bond funds.

Bers and Madura (2000) investigate the existence of performance persistence of closed-end funds over the period 1976 – 1996. This study supplements the inadequacy of research on closed-end funds. Since the closed-end funds are traded on an exchange, the market prices of the closed-end funds are determined by the market forces; therefore subject to investor sentiment which is assumed to be persistent due to price pressure forces and makes the market price performance will also be persistent. This phenomenon is referred to as the "snowballing hypothesis". Due to such difference, the persistence is investigated for two types of performance measures in this study: (1) the market price return, which is the performance of the funds determined by the market, and (2) the net asset value return, which are the actual performance of the underlying assets and thus a proxy for management skill. The authors addressed that the result of the studies on open-ended mutual funds cannot be applied directly to closed-end funds due to some unique features of closed-end funds. Such unique features include few restrictions on available cash and portfolio liquidity as well as low pressure on management to compete for more funds can give closed-end funds an advantage over mutual funds to perform persistently. The authors find the results that show significant evidences of existences of net asset values performance and market price performance persistence for each category of closed-end funds over 12-, 24-, and 36-month holding period. The results differ only slightly between fund groups and over different holding periods.

Droms and Walker (2001a) study the performance persistence of international mutual funds in existence during the period 1977-1996 and document the existence of significant persistence for 1-year holding period, but no for 2-, 3- or 4-year periods. The authors also employ the "winner-winner, winner-loser" contingency table supplemented with statistical z tests and chi-square tests. Both tests reject the null hypothesis of nonexistence of performance persistence only for short-term 1-year period. None of the test statistics for longer-term period are statistically significant at any meaningful level of significance.

Droms and Walker (2001b) document no long-term persistence of returns, expenses, and turnover rates for 151 equity mutual funds over the periods 1971 to 1990. The authors follow the methodologies that have been used in the previous literatures, such as regression analysis and two-way tables, to find the evidence of persistence. However, their focus is on decade performance persistence in which the time horizon is longer than other studies. This research is the first study on the persistence of fund characteristics such as expenses, and portfolio turnovers other than returns. The results of regressing second-decade total returns, alphas, expenses, and portfolio turnovers against first-decade respective variables produce either positive or negative but not significant regression coefficient, b_i. On the other hand, the regression models may provide significant coefficient if the time period is short that indicates short-term persistence of fund characteristics exists. These findings are consistent with the others.

Amenc, Bied, and Martellini (2003) document the evidence of performance persistence of hedge funds over the period January 1994 through December 2000. The authors use data from Credit Suisse First Boston / Tremont (CSFB/Tremont), the company designs and provides CSFB/Tremont hedge fund index and such index chooses 300 funds with at least \$10million assets under management out of 2,600 U.S. offshore hedge funds as its constituent computed on a monthly basis and is free of survivorship bias. The authors classify the hedge funds into nine groups according to the classification criteria of CSFB/Tremont index based on their strategies – convertible arbitrage, dedicated short bias, emerging markets, equity market neutral, event driven, fixed-income arbitrage, global macro, long-short equity, and managed futures. The authors use a different approach from all the previous studies. The authors use the Hurst exponent which is estimated by the rescaled range (*R/S*) method to examine the evidence of persistence in excess returns of hedge fund indexes for these nine investment styles. The Hurst exponent (*H*) is calculated as follow:

$$H = \frac{\ln[(Y_2 - Y_1)/\sigma]}{\ln T},$$

$$Y_1 = \max(Y_t, 0 \le t \le T),\ Y_2 = \min(Y_t, 0 \le t \le T),\ Y_t = \sum_{s=0}^{t} R_s\ .$$

where R_t is defined as the normalized rate of return (subtract the mean). If the Hurst exponent is less than 0.5, the process displays "antipersistence"; if the Hurst exponent is greater than 0.5, the process displays "persistence"; if the exponent is equal to 0.5, the returns do not display any memory, that is, positive excess return is equally likely to be followed by above- or below-average performance. The results show that the Hurst exponents that are significantly above 0.5 for all categories except the managed futures category. The authors conclude that past hedge fund returns provide explanatory power in predicting future hedge fund returns.

Amenc *et al.* set up a predictive model that regresses the returns of the hedge funds on several variables, which include the moving average return on the S&P500, price of oil, change in value of the U.S. T-bill three-month rate, implicit volatility, market volume, and moving-average return on the MSCI World Index ex U.S. The authors also perform out-of-sample testing of the model. The test is performed by finding the "hit ratio" of the model – that is, the percentage of time the predicted direction was valid, in other words, the index went up (down) when the model predicted it would go up (down). The authors find that most of the hit ratios are above 50 percent and one at 95.8 percent in the category of equity market neutral. In summary, the authors may find clear statistical evidence of predictability in various hedge fund returns.

Bilson, Frino, and Heaney (2005) is the first study to examine the evidences of performance persistence in the 480 Australian retail funds over the period September 1991 to June 2000, and document no evidence of performance persistence over a 1-year period, but may document significant evidence of persistence over 3-year period. The authors find that the survivor-only samples exhibit persistence patterns similar to those exhibited in all-fund samples, which clearly indicates that the survivorship bias does not change the persistence patterns in their samples. As the funds are partitioned by fund objectives, the sample of managed stable funds exhibit no evidences but that of managed growth funds still exhibit evidence of performance persistence over a 3-year period. Besides the study on the performance persistence evidences, the authors also show that different performance measure models, Carhart's and Gruber's, may result in dramatic different performance.

A large number of studies examine the performance persistence of mutual fund, but the study on the evidence of pension fund performance persistence is sparse. Since the operations between the mutual fund and pension fund are quite different, the comparison of the evidence of persistence in performance between these two different types of funds is necessary. The differences in operations between mutual funds and pension funds include: 1) pension fund managers control a larger portion of the aggregate wealth than do mutual funds (Coggin, Fabozzi, and Rahman (1993)); 2) they operate in different environments. For example, pension fund managers are reviewed periodically and in details by their clients and independent pension consultants. Poor performing mutual fund investors may withdraw their money and invest in a "hot" fund at any time, that makes the survivorship bias in the study on performance of mutual funds; such kind of withdrawals are not usually seen in pension funds (Christopherson, Ferson and Glassman (1998)).

Christopherson, Ferson and Glassman (1998) provide the first study on the evidence of performance persistence of 273 U.S. pension funds over the period 1979-1990 using conditional performance evaluation techniques, which were developed by Ferson and Schadt (1996). Their study documents evidence of persistence in the performance measured by both unconditional alphas and conditional alphas. Similar to the previous findings in mutual fund performance persistence, they find poor-performing funds tend to be followed by low future returns, and that persistence is concentrated in the poorly performing funds.

Christopherson, Ferson and Glassman's study finds that persistence is concentrated in the poorly performing funds which raises some puzzles left to be answered. Why do the poorly performing managers survive? Is there inefficiency in the market for pension manager services? Are the costs of firing poorly performing managers high enough to justify this persistence of low returns? Do the poorly performing managers deliver valuable services to the plan sponsors that offset their poor investment returns? What strategies for trading and trade execution that the persistently poor-performing managers use? The authors point out future research is needed, using conditional models, to address these puzzles.

Most of the return persistence studies focus in test of evidence of return persistence; few studies find the determinants of the return persistence.

Volkman and Wohar (1995) is the first study investigates the relation between the fund performance persistence and some systematic factors. The authors select three factors to study, which include the fund size, fund objectives, and management fee ratio. The authors use the monthly data of net asset values of 332 funds over the period September 30 1980 and December 31 1989. The results indicate no consistent relation between fund size and performance persistence; the relations between performance persistence and size for small and large funds are negative; however, such relation for medium-size funds is positive. These findings support the hypothesis that as the funds become large their operations will become inefficient. In addition, the results also indicate that the funds with the goal of maximum capital gains demonstrate positive return persistence; the funds with the goal of income on the other hand show negative return persistence. Regarding the last factor management fee ratio, the authors find that the funds with low management fee ratios demonstrate positive return persistence than high-management-fee funds. These findings support the hypothesis that high management fees would offset a fund's abnormal performance.

Conclusively, most of the prior mutual fund performance persistence researches focus on the documentation of persistence, not the determination of the underlying source of performance persistence. Linear multiple regressions are employed to find the determinants of persistence in most of the prior researches, the study for if any other regression model, such as logistic regression, may be used to test the level of persistence is subject to be performed. Amenc *et al.* (2003) propose a measure, the Hurst exponent derived from Rescaled Range Analysis, may be used to find the evidence of return persistence. However, as this measure is free of any assumption, the robustness of such measure is needed to check. Most of the prior researches need to rank the mutual funds and classify them into respective deciles; the level of persistence is measured within these deciles. These studies usually use the magnitudes of the fund raw returns, alpha from single-factor CAPM model, or that from three-factor CAPM model to rank the funds. There are some other ranking criteria provided by some ranking institutions, such as MorningStar Inc. and Lipper Inc. The study on the documentation of the performance persistence may be done based on these rankings.

2.5 Market timing ability

Measuring the performance of mutual funds has been a major focus of academic research. Identifying funds that are successful at timing is not only an interesting academic question but also has great practical importance. To the former, the evidence of superior timing ability. To the latter, such evaluations may provide a guide for the allocation of violates the Efficient Market Hypothesis investment funds.

As much asset allocation funds and balanced funds are aggressive in attempting to time the various markets than most stock mutual funds. There are needs to study this promise. A research done by the Hong Kong Monetary Authority reveals that among 86 fund houses that have operations in Hong Kong, only 12 have taken part in market timing activities. It seems that although the market timing strategies are not common in the Hong Kong mutual fund industry, the trend of taking part more in market timing activities continues.

Some models were developed to measure the market timing ability of funds. However, the results of investigation of market timing are so controversial. Most of the studies found no evidence of market timing ability among all the sample funds. However, recent studies may find evidences of positive market timing ability but not significant, even significant the portion of funds have such strength of ability is small. Some academics have suggested to polish the methodologies are being used to test the market timing ability.

Treynor and Mazuy (1966) document no evidence of significant market timing ability of 57 mutual funds including 25 growth funds and 32 balanced funds over the period 1953 and 1962 by deriving a statistical test. The existence of market timing ability of the fund managers are tested by the presence of curvature of the characteristic line, which is a plot of the rate of return for a managed fund against the rate of return for a market. They define that outguessing the market means anticipating whether the general stock market is going to rise or fall and adjusting the composition of the portfolios, such shifts would make the effective portfolio volatile and make the characteristic line for the respective fund no longer straight, or simply linear. As there are no perfect market timers, the fund managers usually increase the fund volatility gradually as they anticipate good performance in the market. This would produce a smooth curved characteristic line, in other words, the portfolio return is a nonlinear function of the market return. They develop a classic market timing regression, which makes use of quadratic regression techniques and takes the form (thereafter referred to as T-M model):

$$R_{p,t} - R_{f,t} = \alpha + \beta \cdot X_t + \gamma \cdot [X_t]^2 + e_t \tag{2.5.1}$$

where $R_{p,t}$ is the observed rate of return on the portfolio of the fund during the period, $R_{f,t}$ is the risk-free rate of return, $R_{m,t}$ is the market rate of return, α is the expected excess rate of return on the portfolio due to the manager's security selection ability, $X_t \equiv R_{m,t} - R_{f,t}$ is defined as the excess return of the market factor, and γ measures the market-timing ability. If a fund manager increases (decreases) the market exposure of the portfolio prior to a market increase (decrease), the fund portfolio's return should be a convex function of the market return and γ will be positive.

Treynor and Mazuy test the presence of curvature in the characteristic line by employing a least-squares regression technique to fit characteristic-line data for the funds in their sample. That is, finding the coefficient of a quadratic regression model which best fit the excess rates of return of funds against the excess rates of return of S&P Composite Index. They find that among the 57 funds, only one displays significant quadratic regression coefficient; which implies that the other 56 funds in their samples may be assumed to have a straight characteristic line. In other words, almost all the fund managers do not have any market timing ability.

Kon and Jen (1979) use the Quandt (1972) switching regression model to evaluate the market-timing ability of 49 mutual funds over the period 1960 and 1971, and document that the data of most funds are generated by a mixture of two or three regression equations rather than a unique linear model. This empirical evidence indicates that most of the fund managers change their risk levels during the measurement interval. The authors also employ the Black (1972) model and find the evidence that the mutual fund managers individually and on average are unable to consistently forecast the future prices of stocks well enough to cover the management fees, expenses, and commission expenses.

Merton (1981) develops a framework to evaluate the market-timing ability, which does not require any assumption of the knowledge of the distribution of returns on the market. It takes the simple form that the fund manager forecasts either equity market may provide a higher return than the riskless securities, i.e. $R_{m,t} > R_{f,t}$, or the riskless securities may provide higher return than the equity market, i.e. $R_{f,t} > R_{m,t}$. It just calculates the probability of the fund managers' correct forecast but not attempts to predict how much stocks will perform better than the riskless securities such as bonds. The conditional probabilities of a correct forecast are

$$p_1(t) = prob\left[\gamma_t = 0 \middle| R_{m,t} \le R_{f,t}\right] \text{ and } p_2(t) = prob\left[\gamma_t = 1 \middle| R_{m,t} > R_{f,t}\right]. \quad (2.5.2)$$

Merton shows that the existence of market-timing ability will result in $p_1(t) + p_2(t) > 1$.

Henriksson and Merton (1981) develop both parametric and nonparametric approaches to evaluate the market-timing ability. The parametric tests require the assumption of CAPM or a multifactor return structure. The nonparametric tests do not require such assumptions, but do require the knowledge of the actual forecasts.

The nonparametric tests make use the conditional probabilities developed by Merton (1981) and do not depend on any assumption of the distribution of returns. However, the nonparametric tests require the knowledge of the actual forecasts. The null hypothesis that the fund managers have no market-timing ability is $H_0 : p_1(t) + p_2(t) \le 1$ against the alternative $H_1 : p_1(t) + p_2(t) > 1$. The tests follow the hypergeometric distribution are defined by

$$P(n_1|N_1,N,n)=\frac{C_{n_1}^{N_1}C_{n-n_1}^{N_2}}{C_n^N}$$

where n_1 is the number of correct forecasts, given $R_{m,t} \le R_{f,t}$; n is the number of forecasts that $R_{m,t} \le R_{f,t}$; N_1 is the number of observations where $R_{m,t} \le R_{f,t}$; N_2 is the number of observations where $R_{m,t} > R_{f,t}$; and N is the total number of observations. The standard two-tail test will reject the null hypothesis at the confidence level c if $n_1 \ge \bar{x}(c)$ or if $n_1 \le \underline{x}(c)$ where $\bar{x}$ and $\underline{x}$ are determined by solving

$$\sum_{n_1=\bar{x}}^{\bar{n}_1}\frac{C_{n_1}^{N_1}C_{n-n_1}^{N_2}}{C_n^N}=\frac{1-c}{2} \text{ and } \sum_{n_1=\underline{x}}^{x}\frac{C_{n_1}^{N_1}C_{n-n_1}^{N_2}}{C_n^N}=\frac{1-c}{2}. \tag{2.5.3}$$

However, the prerequisites of the knowledge of actual forecasts required by the nonparametric tests are always not obtainable. Henriksson and Merton present a parametric test that is dual-beta excess returns market model and is based on the assumption that the securities are priced according to CAPM. This dual beta model (thereafter referred to as H-M model) is used extensively in many studies on evaluating market timing ability and takes the following form:

$$R_{p,t}-R_{f,t}=\alpha+\beta_1X_t+\beta_2Y_t+e_t \tag{2.5.4}$$

where $Y_t \equiv \max[0,-X_t]$ as the payoff to an option on the market portfolio with exercise price equal to the risk free asset. The least squares estimate of β_2 is an appropriate measure of the fund manager's market-timing ability.

Kon (1983) documents few fund managers in a sample of 37 mutual funds each with monthly rate of return data appear to display positive but not significant market timing ability over the period from January 1960 to June 1976. The author uses the single-period timing performance measure derived by Fama (1972) to measure the timing ability of mutual fund managers:

$$\tau_t=(\beta_t-\beta_T)\pi_{Mt}$$

where β_t is the portfolio risk level, β_T is the target risk level, and $\pi_{m,t}$ is the unanticipated return on the market portfolio and is defined as the deviation of rate of return on the market $R_{m,t}$ from its consensus expectation, $E_t(R_{m,t})$.

$$\pi_{Mt} = R_{m,t} - E_t(R_{m,t})$$

Fama defines that the single-period timing performance measure (τ_t) will be positive if the sign of $\beta_t - \beta_T$ is same as $\pi_{m,t}$ and negative if they are opposite. That is, the fund manager's decision to increase the portfolio risk above the target level in anticipation of a bull market is correct. On the other hand, if the manager increases the portfolio risk in a bear market will have a loss. The overall timing performance for the measurement interval is

$$\tau_0 = \frac{1}{n}\sum(\beta_t - \beta_T)\pi_{m,t} . \qquad (2.5.5)$$

Kon finds the result that of the 37 mutual funds in the sample, 14 had positive overall timing performance estimated by equation (2.5.2) is positive. However, none of them have the figure that is significantly greater than zero shown by the *t*-statistic at 10% level of significance.

The author also performs multivariate tests to test if the fund managers as a group have no special information regarding consensus unanticipated market movements. The results show no test could reject the efficient markets null hypothesis and indicate that the fund managers have no information about the unanticipated market movements as a group.

Henriksson (1984) documents no evidence that the 116 mutual fund managers over the period 1968-1980 are able to time the return on the market portfolio successfully by employing both the parametric and nonparametric tests developed by Henriksson and Merton (1981). Only three funds have significant positive market-timing coefficient that is measured by β_2 in equation (2.5.4). For the nonparametric tests, only four funds exhibited significant superior market-timing ability shown by rejecting the null hypothesis $H_0 : p_1(t) + p_2(t) \leq 1$.

Chang and Lewellen (1984) document that few fund managers appear to have displayed significant market timing ability among 67 sample mutual funds with monthly and quarterly rate of return data over the period 1971-1979. The authors modified the parametric statistical procedure developed by Henriksson and Merton (1981) (namely H&M Model) and used their developed model to test the evidence of market timing ability. Their model (thereafter referred to as C-L model) takes the form

$$R_{p,t} - R_{f,t} = \alpha^* + \beta_d^* X_{d,t} + \beta_u^* X_{u,t} + e_t \qquad (2.5.6)$$

where β_u can be labeled as "up-market beta" of a managed portfolio; β_d can be labeled as "down-market beta", and the positive market-timing ability may be measured by if there is significant difference between β_d^* from β_u^* by testing the alternative hypothesis $\beta_d^* < \beta_u^*$. The authors show that the modified model may provide a more complete appraisal of the components of the performance than the H&M model and may eliminate certain biases in the estimates. The regression results produced by estimating the equation specified in (2.5.6) using the monthly rate of return data show that the mutual fund managers tend to have "reverse skill": the "down-market beta" is slightly higher than the "up-market beta". Of the 67 funds in the sample, four yield a significant difference between two betas at the 5% level of significance; however, most of them (three) are in a negative direction $\beta_d^* > \beta_u^*$, suggesting a perverse market timing ability. The results obtained from using the quarterly return data are similar to that obtained from monthly data. The difference $\beta_u^* - \beta_d^*$ is negative. When quarterly data are used, seven of 67 funds yield a significant difference between two betas at 5% significance level. Same to the previous result, majority of them (five) are in negative direction. The authors conclude that both results are consistent and show that few mutual fund managers have well market timing ability, which supports the general conclusion that the fund managers are unable collectively to outperform a passive investment strategy.

Chen and Stockum (1986) document none of the 43 funds with quarterly return data in the sample has significant positive market timing performance over the period second quarter of 1975 to fourth quarter of 1982. The authors first develop a model that may measure the timing ability by assuming the value of the beta (β_t) is nonstationary and regarding this value as a decision variable instead of a fixed coefficient. The authors developed a quadratic model to measure the timing ability by extending Hildreth and Houck (1968) pure random coefficient model and the variable mean response regression model proposed by Singh, Nagar, Choudbry, and Raj (1976). The authors' model takes the form

$$R_{p,t} - R_{f,t} = \alpha + \beta \cdot X_t + \gamma \cdot [X_t]^2 + \omega_t \tag{2.5.7}$$

where $\omega_t = \mu_t + e_t \cdot X_t$, μ_t is the random shock. The model proposed by them is very similar to that developed by Treynor and Mazuy (1966). The difference is Treynor and Mazuy assumed the residuals (errors) are normally distributed with zero mean and constant variance, while Chen and Stockum allowed the fund beta to be a random coefficient. The results exhibit that none of the funds have significant positive timing performance; on the other hand, six have significant negative timing performance.

Admati, Bhattacharya, Pfleidere, and Ross (1986) is the first study to show that the T-M model described in equation (2.5.1) is an appropriate model to identify the existence of market timing ability under some specific assumptions. The authors use a model in which they assume a manger with constant absolute risk aversion responds to a private signal about the future market return by adjusting the proportion of his portfolio in stocks as a linear function of the signal. They may prove that the timing coefficient γ is significant positive if the manager increases his sensitivity to stocks when the market return is increasing. Thereafter, the T-M model is the most widely used model to investigate the existence of market timing skills within the fund managers.

Jagannathan and Korajczyk (1986) document the evidence that it is possible to construct a portfolio that shows artificial market timing ability even no true market timing ability exists. The authors present the effect, in particular, of investing in options or levered securities will show spurious market timing. The authors first questioned two puzzles in the previous literatures; the first is why most of the funds exhibit negative market-timing ability; the second is that why there is always negative correlation between the measures of security selection and market timing (Kon, 1983; Henriksson, 1984). They did not support Henriksson's explanations for these phenomena, including errors-in-variables bias, misspecification of the market portfolio, and use of a single-factor rather than a multifactor asset-pricing model. Instead, they propose the explanation that relies on the nonlinear payoff structure of options. The authors find the evidence that more concentration on option-like stocks would provide higher measure of market timing although the true market-timing ability does not exist. These results also provide explanation why most funds have negative measures of market timing as these funds invest most of their capitals in "higher-quality" (i.e. less option-like) stocks. The authors propose a test to distinguish the spurious and true timing ability.

The authors simulated the OLS estimate results of the equation (2.5.4) for the portfolio that consists of a call option. The results show that the values of the measure of the market-timing ability ($\hat{\beta}_2$) increases monotonically as the ratio of exercise price to the value of the market price increases. The authors then constructed two portfolios, one is a market-value-weighted portfolio (VW), and the other is an equally weighted portfolio (EW) of NYSE stocks over the period 1926 to 1981. They modified the HM model by adding one dummy variable to isolate the January effect. It takes this form:

$$R_{p,t} - R_{f,t} = \alpha + \beta_1 X_t + \beta_2 Y_t + \delta \cdot d_t + e_t \tag{2.5.8}$$

where d_t is the dummy variable that equals unity during January and zero otherwise.

The authors made two conjectures. The first is since the VW portfolio has fewer option-like stocks, the conjecture predicts that $\alpha > 0$ and $\beta_2 < 0$ for the regressions estimated by (2.5.8). The other is opposite to the previous one, the estimated regression coefficients should be $\alpha < 0$ and $\beta_2 > 0$ for the EW portfolio. The results support their conjecture, which support the evidence that more concentration on option-like stocks would provide higher measure of market timing although the true market-timing ability does not exist. These results also provide explanation why most funds have negative measures of market timing as these funds invest most of their capitals in "higher-quality" (i.e. less option-like) stocks. The authors propose a test to distinguish the spurious and true timing ability.

Lee and Rahman (1990) use the H-M model to examine the market timing and stock selection ability of a sample of 93 mutual fund with monthly return data provided by Center for Research in Security Prices (CRSP) from January 1977 to March 1984. The authors, on the other hand, find a different result from Kon (1983) when they use the data cover the period next to that in Kon's study and employ different models. The results show there are sixteen funds out of 93 (17.2%) exhibit market-timing ability but are significantly different from zero at 5% significance level. The correlation coefficient that shows the relationship between the measure of stock selection (α) and market timing (β_2) is found to be positive.

Cumby and Glen (1990) document that the managers of 15 U.S.-based internationally diversified funds all exhibit perverse market timing ability during the period from January 1982 through June 1988, if the T-M model with Capital International World Index as benchmark is employed; five of them show significant negative β measures at 5% level of significance. If the monthly return figure in October 1987 is excluded, the evidence of perverse timing is reduced.

Chan and Chen (1992) document no evidence of excel in market timing in a sample of 19 funds over the period ranging from December 30, 1983, to March 23, 1990. The authors use the C-L model specified in equation (2.5.6). The results show that more than half (twelve) of the sample funds have positive measure of stock selection ability (α); however, the market-timing ability is doubtful, only five have $\beta_u > \beta_d$ at a 5% significance level. On the other hand, large portion of the samples have poor market-timing skill, 14 have significant $\beta_d > \beta_u$, which indicates these funds allocate assets in a way opposite to the movement of the market. Three portfolios are then constructed using a portion of the samples but with different time horizons. The results reveal that longer time period may produce larger α's, however the t-test still shows that there is a significant $\beta_u < \beta_d$. To see if the market timing ability becomes better without the influence of market crash in 1987, the authors exclude the observations during the weeks ending October 19 and 26, 1987. Once again, the results show that there is a significant $\beta_u < \beta_d$, which shows the market crash did not influence the funds' timing ability. Among all funds in the sample, only one exhibit a slight increase in β_u and decrease in β_d, which indicates this fund had some adjustments in its portfolio during the market crash in 1987. The authors then use the monthly data and perform the test that is same to the first one; they find a very similar result and conclude that market-timing ability measures are not biased when the true horizon is unknown.

Ferson and Schadt (1996) document the results are different if the usually used models are conditional on public information. The authors use the monthly return data for 67 mutual funds from 1968 to 1990 with the assumption that the mutual fund managers trade based on monthly horizon and the returns include reinvestment of dividends and are net of expenses excluding load charges and exit fees. To study the market timing, the authors make use of the Treynor and Mazuy (1966) quadratic regression model (namely, T-M model), and the Henriksson and Merton (1981) dual-beta regression model (namely, H-M model). The authors propose the conditional version of the T-M model (2.5.9) and that of H-M model respectively (2.5.10), which capture the responses of the beta to the public information, Z_t:

Conditional T-M model: $R_{p,t} - R_{f,t} = \alpha + \beta \cdot X_t + C \cdot Z_t X_t + \gamma \cdot [X_t]^2 + e_t$ (2.5.9)

where the coefficient C captures the response of the manager's beta to the public information, Z_t.

Conditional H-M model: $$\begin{aligned} R_{p,t} - R_{f,t} &= b_d \cdot R_{f,t} + B_d \cdot [Z_t, R_{f,t}] + \gamma \cdot R^*_{f,t} \\ &+ \Delta \cdot [Z_t, R^*_{f,t}] + e_t \end{aligned} \quad (2.5.10)$$

where $R^*_{f,t} = R_{f,t} \cdot I\{R_{f,t} - E[R_{f,t}|Z_t] > 0\}$, $\gamma = b_{up} - b_{down}$, and $\Delta = B_{up} - B_{down}$. $I\{\bullet\}$ is the indicator function. No market timing ability may be tested by the null hypothesis that γ and Δ are zero, against the alternative hypothesis $\gamma + \Delta \cdot Z_t > 0$ that implies there is positive market timing ability.

Ferson and Schadt use five economic variables to account for public information, they include: (1) the one-month lagged Treasury bill yield, (2) the lagged dividend yield of the CRSP value-weighted New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) stock index, (3) a lagged measure of term spread, (4) a lagged quality spread in the corporate bond market, and (5) a dummy variable for the month of January. The authors find the evidence that unconditional and conditional versions of T-M model and H-M model have quite different results. The evidence of preserve market timing is improved and that for typical fund is removed. The unconditional T-M model shows there are 44 funds have negative timing coefficient, the conditional version reveals only 27 are negative. The results are similar in H-M model. There are 46 funds exhibit negative timing coefficient if unconditional H-M model is used to measure the timing ability, the number of funds that exhibit negative timing ability is also lower when conditional model is used, there are 25 only. The authors explain that it is because the traditional measures take more market exposure when stock returns are low.

Ferson and Warther (1996) replicate the conditional version of T-M model (Ferson and Schadt (1996)) to evaluate the existence of evidence of market timing ability in 63 open-end mutual funds during the period 1968-1990. The authors also used the unconditional version of T-M model as a comparison. However, Ferson and Warther propose two public information variables only in this study: (1) lagged value of the market dividend yield $(D/P)_{t-1}$; and (2) lagged value of short-term Treasury yield $(TB)_{t-1}$. The conditional version of T-M model is as follow:

$$
\begin{aligned}
R_{p,t} - R_{f,t} &= \alpha + b_0(R_{m,t} - R_{f,t}) + b_1\left[(R_{m,t} - R_{f,t})\times(D/P)_{t-1}\right] \\
&\quad + b_2\left[(R_{m,t} - R_{f,t})\times(TB)_{t-1}\right] + \gamma(R_{m,t} - R_{f,t})^2 + e_t
\end{aligned}
\tag{2.5.11}
$$

The results of unconditional version of T-M model exhibit that more than two-thirds (68.3%) of the individual funds have preserve market-timing ability, including more than 70% of the growth funds and 100% of the maximum gain funds. The timing coefficients in unconditional version are significantly negative in the group of maximum gain funds, which is consistent with some previous studies. When conditional TM model is employed to evaluate the market timing ability, the authors find evidence similar to Ferson and Schadt (1996). They find that the proportion of sample funds which exhibits negative market timing coefficients reduces to 41.3%, the proportions of negative coefficients in sample growth funds and maximum gain funds reduce to 42.9% and 75% respectively.

Hallahan and Faff (1999) document little evidence of market-timing ability exists in the data of a sample of 65 Australian equity trusts from January 1988 to September 1997. The authors replicated several models that are mostly used in the studies of market-timing ability, including the Treynor and Mazuy (1966) quadratic excess market model (T-M model), and Henriksson and Merton (1981) dual-beta excess returns market model (H-M model). The authors also employ some specification tests proposed by Jagannathan and Korajczyk (1986). The results are quite similar to some other studies on market-timing ability in U.S., including little evidence of market-timing ability and negative association between the measures of market timing and stock selection. The authors find no market-timing model may dominate the other. However, the results reveal that the cubic market model specification augmented by Jagannathan and Korajczyk (1986) fits the data well as there are a quarter of their samples have significant cubic term at 5% level of significance. The results that most of the currently used models cannot fit the data well than the cubic specification test reveals the evidence of inadequacy of commonly used measures and there may be a possible room on the improvement of the current models.

Gallagher (1999) also document little evidence of market-timing ability exists in the Australian pooled superannuation funds during the period 1991-1998. The author finds that the all-sample-fund portfolio does not exhibit superior stock-selection and market timing ability indicated by statistically significant negative alpha and market timing coefficients. Regarding these two components of individual fund manager's ability, the author finds that the individual fund is generally more successful in security selection rather than market timing. Insignificant moderate negative correlation between these two components regardless of T-M or H-M timing models is found. That study demonstrates an appropriate benchmark that is consistent with the investment strategies and assets held in diversified portfolios is important. Finally, the author suggests that incorporating public economic variable (conditional timing models) may be done in the further studies.

Volkman (1999) is the first study to extend the Carhart four-factor CAPM model to measure the market-timing ability. The author examines the timing ability of 332 funds with survivorship-bias-free monthly return data over the period from September 30 1980 to October 31 1990. The author incorporates Carhart (1997) four-factor model and the T-M market-timing model to have the following four-index T-M model (thereafter referred to as TM-FF4 model) to measure the market timing performance:

$$R_{p,t} - R_{f,t} = \alpha_{i,t} + \beta_1 X_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 PR1YR_t + \gamma \cdot [X_t]^2 + e_{i,t} \tag{2.5.12}$$

The results show that, on average, fund managers demonstrate significant perverse market timing performance. However, the author finds that the measures of the stock selection are positive but not significant. The author then tests the conjecture that whether the fund managers focus on selectivity performance at the expense of market-timing performance, the results indicate a negative correlation between the fund's timing and selectivity performance that support such conjecture. The influence of the key operating factors on mutual funds market-timing ability is also examined. The sample mutual funds are segregated by management compensation, size, and stated risk objective.

The results indicate the high-compensation funds possess better market-timing ability; the market-timing ability is indifferent between with- and without-compensation funds; large funds have a more inferior timing performance; and high-risk funds have a larger negative timing performance. The author uses the rank correlation coefficient to compare the market timing performance before and after 1987 market crash. The rank correlation coefficient is low but significantly different from zero, which indicates few funds correctly anticipated future market movements during the periods of high market volatility.

Busse (1999) is the first study using daily data to examine the ability to time the market volatility. The author use a sample of 230 mutual fund daily return data that combined both the net asset values and dividends excluding sector, balanced, and index funds over the period 1985 through 1995. For comparison, the author also uses the monthly data. The author has modified the single-factor, three-factor and four-factor market timing models to suit for testing volatility market timing ability by using daily data, they take the form:

Single-index volatility timing model:

$$\begin{aligned} R_{p,t} - R_{f,t} &= \alpha + \beta_{0m,p}\left(R_{p,t} - R_{m,t}\right) + \gamma_p\left(\sigma_{m,t} - \overline{\sigma_m}\right)\left(R_{p,t} - R_{m,t}\right) \\ &\quad + \beta_{l,m,p}\left(R_{p,t-1} - R_{m,t-1}\right) + e_t \end{aligned} \tag{2.5.13}$$

Three- and four-index volatility timing models:

$$R_{p,t} - R_{f,t} = \alpha + \sum_{j=1}^{k}\left[\beta_{0m,p}\left(R_{p,t} - R_{m,t}\right) + \beta_{l,m,p}\left(R_{p,t-1} - R_{m,t-1}\right)\right] + \gamma_p\left(\sigma_{m,t} - \overline{\sigma_m}\right)\left(R_{p,t} - R_{m,t}\right) + e_t \tag{2.5.14}$$

with $k = 3$ or $k = 4$. Similar to the usual three- and four-index models, *SMB, HML*, and *PR1YR* return series are constructed. To model the market volatility, the author use EGARCH model and the implied volatility of an option on a market index provided by the Chicago Board Options Exchange (CBOE). The results of daily data for all three timing specifications show that the mutual fund betas respond negatively to market volatility; and the volatility coefficients of the mutual funds are significantly less than those of the random control sample, which indicate the funds decrease market exposure when market volatility is high. This result is particularly strong for growth funds, which indicates the growth funds are more aggressive to time the market volatility than the others. The timing coefficients for all categories of funds in the four-index results are more negative than those in the three-index results, which indicate evidence of conditional volatility timing. The authors also use the monthly data and find similar results.

Goetzmann, Ingersoll, and Ivković (2000) document few funds out of a sample of 558 funds exhibit significant market-timing skill over the period 1988 through 1998 by using the monthly return data. The authors simulate 10 years data of daily excess return with a mean of 10% and annual standard deviation of 16%. The results show that the H-M model of market-timing ability may be biased downward when applied to the monthly returns that are compounded by the daily figures. The authors suggested that the need to collect daily figures is not necessary. The authors notice one problem that many market-timing ability studies face - the difference in frequency between the trading and return measurement. Although the best solution to this problem is to collect data corresponding to the frequency of the timing decisions, it is not possible. They suggest an alternative is to collect daily data on risky asset alone such as S&P 500 returns and adjust the currently used models. The authors adjusted the original H-M model and Fama-French three-factor model to measure the timing skill that correct the problem mentioned above take the following forms:

$$\text{Adjusted-HM: } R_{p,t} - R_{f,t} = \alpha + \beta(R_{m,t} - R_{f,t}) + \gamma \cdot P_{m,t} + e_t \qquad (2.5.15)$$

$$\text{Adjusted-FF3: } R_{p,t} - R_{f,t} = \alpha + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \gamma \cdot P_{m,t} + e_t \qquad (2.5.16)$$

where $P_{m,t} = \left[\left(\prod_{\tau \in month(t)}^{t} \max\{1 + R_{m,\tau}, 1 + R_{f,\tau}\}\right) - 1\right] - R_{m,t}$ is the value added by perfect daily timing per dollar of fund assets. The authors employ four different models: the classic H-M model, the adjusted H-M model, the three-index H-M model (HM-FF3 model) and the adjusted-FF3 model simultaneously to detect the market-timing skills. The results show that few funds exhibit significant positive timing skill under either measure, the lowest is 2 when adjusted H-M model and the highest is 31 when HM-FF3 are used as a measure. Similar to the previous studies, the measure of stock selectivity skill (α) and the measure of market-timing skill (γ) are all negative correlated under either measure. The authors choose a sample of six index funds from their samples of 558 funds and find that the three-index models are less biased to assess the market-timing skill than the single-index CAPM model whatever adjusted or not as the results are not quite different between HM-FF3 and adjusted-FF3. Besides, the authors also choose 55 index funds that are not in the their samples of 558 funds in the same time interval and find that the result of adjusted-FF3 specification is more consistent than that of HM-FF3 specification, which suggest that adjusted-FF3 specification is the most unbiased when assessing market-timing ability.

Bollen and Busse (2001) use the same data as Busse (1999) and document that the mutual funds exhibit significant timing ability more often than previously documented. To control for the spurious reject of null hypothesis of no market timing ability documented by Jagannathan and Korajczyk (1986), the authors construct a set of synthetic matched sample of funds that mimics the holding of the actual funds but have no market-timing ability, by randomly selecting 100 stocks chosen from the different asset classes. The authors incorporated Carhart (1997) four-factor model with the T-M market-timing model and the H-M timing model respectively to have four-factor T-M (TM-4) and four-factor H-M (HM-4) models to measure the market timing performance. The monthly return data are also used as a comparison. The result shows that when daily return data are used instead of monthly, the percentage of funds exhibit significant positive and negative timing is higher regardless of the current TM-4 or HM-4 models. The results then show there are more funds with significant market-timing ability than the corresponding synthetic fund for both T-M and H-M model, which indicate the measured market-timing ability may not be explained as a spurious statistical phenomenon.

Fung, Xu, and Yau (2002) study the market timing ability of a sample of 311 global hedge funds, which mostly invest in equities, over the period 1994 through 2000. The authors document that the global hedge fund managers do not demonstrate positive market-timing ability, which does not support the widely held belief that the hedge funds are more aggressive in hedging and diversifying market risk. The authors employ H-M model (2.5.4), and Chang and Lewellen (1984) extended version (2.5.6) to examine the timing ability of the hedge fund managers. The results of H-M model show that most of the funds have negative measure of the market-timing ability (β_2), and the results of extended model show the down-market beta (β_d^*) is generally higher than the up-market beta $\left(\beta_u^*\right)$, which indicates the hedge fund returns are more affected in down markets and the claims of the hedge fund industry that the hedge funds may provide good downside protection to investors seem not to be supported.

Gregoriou (2004) use the monthly data of 227 live and 210 dead offshore and onshore funds of hedge funds (FOFs) over the period 1993-2001 to compare the adequacy of unconditional and conditional versions of T-M and H-M models. The authors use three economic variables: (1) lagged default spread, (2) lagged term premium, and (3) lagged intra-month implied volatility (VIX) to account for public information in the conditional models. The results show that the conditional models are preferable over unconditional as the conditional models are better fit, shown by higher R-square values. The market timing effects of the FOFs are often positive and significant in unconditional models; however, they are no longer significant when conditional models are being used. This change is due to the strong predictive power of the conditional variables introduced into the models. The magnitude of the alphas is smaller when conditional models are employed. Overall, the authors conclude that including conditioning variables may help in analyzing hedge fund performance, including the FOFs.

Kok, Goh and Wong (2004) employ the standard T-M and H-M models but with GARCH(1,1) specification to evaluate the stock selection and market timing ability of 36 unit trusts in Malaysia during the period January 1995 to June 2001 and document that the Malaysian unit trusts possess inferior or no market timing ability. Regarding the stock selectivity, the authors find that the unit trusts possess superior stock selection ability in both pre-crisis and post-crisis periods. Similar to the findings of Hallahan and Faff (1999), the authors also find that the currently used market timing models have misspecification problem. Regarding different types of unit trusts, they find that balanced funds performed better than the growth funds before the financial crisis and during the crisis in 1998.

Bensen and Faff (2006) evaluate the impact of fund flows on the market timing ability of Australian international equity fund managers over the period October 1989 to September 1999. The authors amend the conditional version of standard T-M by adding two additional variables: excess return on the SDR index to control for the effects of exchange rate risk by adding an exchange rate factor, and relative fund flow measures which is defined as (a) a percentage of fund value and (b) a percentage of sector flow respectively to capture the impact of fund flow on the performance evaluation. Similar to the previous studies of using conditional model, standard set of public economic information variables are used. The results indicate phenomenon similar to the previous studies done in US that the managers are unable to outperform the market and possess inferior market timing abilities. As the market timing model is controlled for fund flow that is defined as a percentage of sector flow, the negative timing performance is found to reduce but the abnormal returns seem not to be influenced by adding that variable. However, such reduction becomes not evident as the fund flow is defined as a percentage of fund value.

The work on the measurement of market-timing ability is still continuing. Many puzzles have to be solved. They include: which model is the best to capture the mutual fund managers' market-timing ability; and whether the timing ability makes the Jensen measure (α) spuriously negative although the fund managers have stock selection ability. Although the use of market-timing strategy is not common in Hong Kong fund companies, if there are actually no fund managers have tried to time the market will be the interest of this study. In the area of market-timing ability, there are some areas to study especially in the emerging MPF scheme.

CHAPTER 3 PERFORMANCE OF MPF EQUITY FUNDS

3.1 Introduction

Although the overall returns to the MPF funds in their first two years (i.e. 2001 and 2002) of operation was negative, their performance has improved over the following years. Are the MPF funds still a good investment for retirement to the Hong Kong public? The overall performance of Hong Kong MPF over the period of the first four years of operation (i.e. 2001 to 2004) has not been compared with the market benchmark; especially no studies adjust the performance. In other words, no studies use the adjusted-return to evaluate the performance of MPF. The purpose of this chapter is to adopt some well-developed adjusted-return calculation means to evaluate the funds' performance, such as Jensen's alpha and Fama-French three-factor alpha.

This study provides the first comprehensive study of Hong Kong MPF. The sample consists of monthly prices of Hong Kong MPF provided by all the MPF scheme providers. Some measures are employed to evaluate the funds' performance such as the traditional Jensen measure (Jensen (1968, 1969)), conditional Jensen measure (Ferson and Schadt (1996)), Fama-French three-factor model (Fama and French (1993, 1995, and 1996)), and the conditional version of Fama-French three-factor model.

The remaining part of this chapter is structured as follows: section 3.2 outlines the research methodologies used to evaluate the adjusted performance for equity funds using traditional and conditional approaches, the alternative performance to evaluate the adjusted measures, the performance of fixed-income funds and index funds. Section 3.3 gives the description of the data. Section 3.4 presents the empirical results on the risk-adjusted performance using unconditional and conditional approaches; alternative performance analysis; performance analysis of internationally equity funds and that of index funds. Section 3.5 provides a summary of this chapter.

3.2 Research methodology

3.2.1 The performance analysis of MPF equity funds

Traditional Jensen alpha measure

The most common employed measure to evaluate the performance of mutual (or pension) equity funds in previous studies is Jensen's alpha obtained by CAPM model. It is assumed that investors evaluate performance on the basis of risk and return, and that fund managers trade using a one-month horizon. Monthly returns of the funds will then be used in the Jensen model. Suppose $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio; the Jensen measure refers to the intercept α in the regression model of return of the fund, *i,* in excess of the 1-month risk-free rate on the excess return on the market portfolio as follow:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta\left(R_{m,t} - R_{f,t}\right) + e_t \tag{3.2.1}$$

If the CAPM is a correct model of equilibrium returns, the portfolio of a fund should lie on the security market line and the value of Jensen alpha, α_i in equation (3.2.1), should be zero. Therefore, a significant positive Jensen alpha indicates superior performance if a fund manager possesses stock selection ability to outperform the market but no timing ability. The Jensen alpha may be estimated by the least squares regression of equation (3.2.1) and it represents the constant periodic return that the fund manager is able to earn above an unmanaged portfolio which is having identical market risk.

Conditional Jensen alpha measure

The unconditional models have one weakness that the superior performance may be incorrectly attributed to manager skill rather than abnormal performance and the use of public information. Ferson and Schadt (1996) have recognized the importance to incorporate changing economic conditions in evaluating mutual fund performance. They find that some fund managers shift their portfolios based on public information of economic conditions, the traditional Jensen measure may be biased if it does not take this effect into account. Following Shanken (1990), they approximate the beta in the conditional model that is assumed to be a linear function of public information vector Z_t that captures changing economic conditions, and is given by

$$\beta_i(Z_t) = b_{1,i} + b'_{2,i} Z_t \tag{3.2.2}$$

where $b_{1,i}$ is the unconditional mean of the conditional beta $E[\beta_i(Z_t)]$. The coefficient $b_{2,i}$ tracks how b_i varies with the innovation of the conditioning variable vector $z_t = Z_t - E(Z_t)$. By multiplying the excess market return $R_{m,t} - R_{f,t}$ to $\beta_i(Z_t)$ given by equation (3.2.2), the following regression equation is obtained:

$$R_{i,t} - R_{f,t} = \alpha + b_{1,i}(R_{m,t} - R_{f,t}) + b'_{2,i}[Z_t(R_{m,t} - R_{f,t})] + e_t \tag{3.2.3}$$

The additional factor may be interpreted as the returns on self-financing dynamic strategy that purchases z_t units of market portfolio by borrowing on the risk-free market.

The conditional Jensen model uses public information variables that are similar to those have been identified as useful for predicting risks and security returns over time in previous studies, but will be adjusted to comply with Hong Kong investment market. The following public information variables are used: (1) the lagged level of 1-month MPFA prescribed saving rate that is closest to 1 month to maturity at the end of the previous month (SAV_{t-1}); (2) the dummy variable for the month of January (JAN_t); (3) the lagged dividend yield in the Hang Seng Index at the end of the previous month (DIV_{t-1}); (4) the lagged measure of the slope of the term structure that is the change in the term spread and is the difference between the maturity 10-year HKMA Exchange Fund Note and the 91-day HKMA Exchange Fund Bill, both are annualized monthly averages $(TERM_{t-1})$; and (5) the lagged quality spread in the corporate bond market that is the change in the corporate bond default-related yield spread and is the difference between the Moody's BAA-rated corporate bond yield and the AAA-rated corporate bond yield, using the monthly average yields for the previous month (DEF_{t-1}).

The dividend yield represents the previous 12 months of dividend payments for the Hang Seng Index divided by the price level at the end of the previous month on the Hang Seng Index.

The change in the term spread is an important predictor of future economic conditions. A positive slope of the yield curve implies higher future spot rates if it is assumed that forward rates are unbiased estimators of future spot rates. Estrella and Hardouvelis (1991) and Estrella and Mishkin (1997) show that increase in the slope of the term structure reveals improvements in real economic activity; while Estrella and Mishkin (1998) show that decreases in the slope of the term structure on the other hand indicates a likelihood of future recessions. It is expected that the funds should respond to the changes in the term structure because the fund managers relate the changes in term structure with the changes in economic situations.

The change in the corporate bond default-related yield spread is the anticipation of the future level of creditworthiness of firms. Breeden (1979) and Harvey (1988) show that agents borrow more in anticipation of higher future consumption in response to a positive supply shock will increase the interest rates. Simultaneously, expected improvement in economic conditions leads to lower credit risk and a narrowing of the default spread. On the other hand, the agents will invest more if they expect a recession appear in the future, this lowers the yields and increases payoffs during the recession. Simultaneously, expected deterioration in economic situations leads to higher credit risk and a widening of the default spread. It is expected that the funds should also respond to the changes in the corporate bond default-related yield as the fund managers relate the changes in default-related yield spread with the changes in economic situations.

These three public information variables (dividend yield, change in the term spread, and change in the corporate bond default-related yield spread) are available over the entire sample period (2001-2004). Most of the academic studies have shown these three variables may be used to predict stock returns. Pesaran and Timmermann (1995) cite a number of additional studies from the 1930s to the early 1960s that emphasize stock market predictability based on interest rates, dividend yields, and other cyclical indicators.

Given these five economic variables, the public information vector Z_t may be a vector of the five economic variables mentioned above and the product $b_{2,i}' \cdot Z_t$ will be a linear combination of these five variables as follows:

$$
\begin{aligned}
&b'_{2,i} \cdot Z_t = b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + \\
&b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}
\end{aligned}
\tag{3.2.4}
$$

where $b_{SAV,t}$, $b_{JAN,t}$, $b_{DIV,t}$, $b_{TERM,t}$, and $b_{DEF,t}$ measure the extent to which the conditional beta diverges when market indicators are taken into account.

The conditional Jensen measure specified in (3.2.5) may be derived by letting the product $b'_{2,i} \cdot Z_t$ be a linear combination of the five variables mentioned in equation (3.2.4).

$$
\begin{aligned}
&R_{i,t} - R_{f,t} = a + \\
&\left(b_{1,i} + b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}\right) \times \\
&\left(R_{m,t} - R_{f,t}\right) + e_t
\end{aligned}
\tag{3.2.5}
$$

The public information variables represent economic information available to the public for making predictions on the market returns. If a fund manager rationally responds to the information and adjusts the portfolio accordingly, the conditional information variables may capture such ability and the conditional Jensen model is expected to produce a smaller alpha than the traditional model.

3.2.2 Alternative measures of performance analysis for MPF equity funds

Fama and French (1992) show that firm size and firm value (measured by book-to-market (*B/M*) ratio) are the most significant factors other than the return on the market portfolio for explaining the average returns on the US stock markets over the period 1963-1990 effectively. They document that small firms tend to have lower earnings on assets than big firms, and the firms that have a high B/M ratio also tend to have low earnings on assets. Fama and French (1993) show that the excess return on market and size and *B/M* ratio may capture the common variations in the stock market.

To test if the underperformance of the MPF stems from investing in large and low *B/M* ratio stocks, the commonly used model Fama-French three-factor model (Fama and French (1993)) may be used. Fama-French three-factor model applies fundamental factor model where the explanatory variables are returns on a market stock portfolio and returns on a mimicking portfolio for the prespecified return factors. The prespecified stock market factors chosen in this thesis are size and book-to-market (*B/M*) ratio. Some studies have found other market factors such as returns of large stocks, small stocks, government bonds, and low-grade bonds may be the explanatory variables. Elton, Gruber, Das, and Hlavka (1992) use three factors; Sharpe (1988, 1991) uses 10 to 12 factors; and investment firm BARRA uses as many as 68 factors in their model. A relatively parsimonious factor model is chosen because the application is mutual funds, as opposed to individual common stocks. Moreover, the conditional model requires that we estimate more parameters than an unconditional model, so parsimony becomes important.

To compare a Fama-French three-factor model with a traditional Jensen measure, this thesis includes two additional explanatory variables, *SMB* and *HML*. In order to construct these two variables, it is necessary to firstly construct six portfolios from all stocks included in the FTSE MPF Index. These portfolios are used to compute the respective benchmark indices for different groups of MPF funds. The stocks are ranked on size and the median size is then used to split the stocks into two groups: small (*S*) and big (*B*). The stocks are also ranked on the basis of *B/M* ratios and are then divided into three groups based on the breakpoints for the bottom 30% (Low, *L*), the middle 40% (Medium, *M*), and the top 30% (High, *H*). The intersections of the two sizes and the three book-to-market ratios groups yield six portfolios, *S/L, S/M, S/H, B/L, B/M*, and *B/H*. Since these six portfolios contain no private information, they should have zero intercepts when regressed on benchmarks and may be served as a basis for comparison with the performance of the MPF funds.

The first additional explanatory variable included in stock-market factor time-series regression is *SMB* (small minus big), used to mimic the risk factor in returns related to size: it is the difference between the average returns on small-stock portfolios (*S/L, S/M*, and *S/H*) and the average returns on big-stock portfolios (*B/L, B/M,* and *B/H*). The behind rationale of this variable is reported in Fama and French (1992) that there is a strong negative association between stock returns and size: smaller firms tend to have higher average returns. The economic rationale is that small firms' earnings are more sensitive to economic conditions, with a resulting higher probability of distress during bad economic prospects; the other concern is that small firms have greater information asymmetry for investors. These two factors make higher required returns for stocks of small firms. Any book-to-market effect is removed in the *SMB* since the book-to-market ratios are approximately equal between these two portfolios. The return of the mimicking *SMB* portfolio should be free of the influence of the *B/M* ratio effect and should characterize the return difference between large and small stocks.

The second explanatory variable is *HML* (high minus low), used to mimic the risk factor in returns related to value measured by book-to-market (*B/M*) ratios: it is the difference between the average returns on stocks with high-*B/M* portfolios (*S/H* and *B/H*) and the average returns on low-*B/M* portfolios (*S/L* and *B/L*). Fama and French (1992) report a strong positive association between the stock returns and book-to-market value: firms with higher *B/M* ratios tend to have higher average returns. This procedure gives a portfolio free of size effect. The return of the *HML* portfolio should be free of the size influence and should capture the difference in returns of the high and low *B/M* ratio stocks.

By combining the original market factor and the additional size and value factors, the Fama-French three-factor time-series model of excess stock return on the stock-market factors may be as follows:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + s \cdot SMB_t + h \cdot HML_t + e_t \tag{3.2.6}$$

The coefficients in this model have similar interpretations to the single factor Jensen alpha measure. A positive α indicates the existence of superior abnormal performance in the equity fund managers. β measures the market risk, s measures the exposure to size risk, and h measures the exposure to value risk.

The regression coefficients s and h may be interpreted as follows: a positive *SMB* coefficient s indicates that the fund manager is tilted toward smaller stocks and similarly a positive *HML* coefficient h indicates that the fund manager is tilted toward high B/M ratio stocks.

There are two benefits of using Fama-French three-factor alpha measure rather than single-factor Jensen alpha measure. Firstly, the three-factor alpha measure may explain much more variation observed in realized returns expressed by usually higher value of *adj.* R^2. Secondly, the three-factor alpha measure may be used to show that a positive traditional Jensen alpha measure may be a result of exposure to either *SMB* or *HM*L factors, rather than fund manager stock selection performance.

3.2.3 Conditional version of Fama-French three-factor alpha measure

Equation (3.2.6) is known as unconditional three-factor model. Alternatively following Ferson and Schadt (1996), the Fama-French three-factor model may incorporate changing economic conditions. By multiplying $\beta_i(Z_t)$ given by equation (3.2.2) to the excess market return $R_{m,t} - R_{f,t}$ and two explanatory variables in equation (3.2.6), the following regression is obtained:

$$\begin{aligned} R_{i,t} - R_{f,t} = \alpha + (b_{1,i} + b_{2,i} Z_t)(R_{m,t} - R_{f,t}) + (b_{1,i}^{SMB} + b_{2,i}^{SMB} Z_t) SMB_t \\ + (b_{1,i}^{HML} + b_{2,i}^{HML} Z_t) HML_t + e_t \end{aligned} \tag{3.2.7}$$

where b_1, b_1^{SMB}, and b_1^{HML} are average conditional betas, and b_2, b_2^{SMB}, and b_2^{HML} are vectors of beta-responsive coefficients with respective to the factors. Equation (3.2.7) is known as conditional version of Fama-French three-factor model.

Suppose the same five economic variables specified in section 3.2.1 are still used to indicate the public information, the conditional variables $b_{2,i}' Z_t$, $b_{2,i}^{SMB} Z_t$ and $b_{2,i}^{HML} Z_t$ in the conditional Fama-French three-factor model are linear combinations of these five public information variables and are same to that described in equation (3.2.4). Substituting equation (3.2.4) in (3.2.7) yields:

$$\begin{aligned} & R_{i,t} - R_{f,t} = \alpha + \\ & (b_{1,i} + b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}) \times \\ & (R_{m,t} - R_{f,t}) + \\ & (b_{1,i}^{SMB} + b_{SAV,t}^{SMB} \cdot SAV_{t-1} + b_{JAN,t}^{SMB} \cdot JAN_{t-1} + b_{DIV,t\,DIV,t}^{SMB} \cdot DIV_{t-1} + b_{TERM,t}^{SMB} \cdot TERM_{t-1} + b_{DEF,t}^{SMB} \cdot DEF_{t-1}) \times \\ & SMB_t + \\ & (b_{1,i}^{HML} + b_{SAV,t}^{HML} \cdot SAV_{t-1} + b_{JAN,t}^{HML} \cdot JAN_{t-1} + b_{DIV,t\,DIV,t}^{HML} \cdot DIV_{t-1} + b_{TERM,t}^{HML} \cdot TERM_{t-1} + b_{DEF,t}^{HML} \cdot DEF_{t-1}) \times \\ & HML_t + e_t \end{aligned} \tag{3.2.8}$$

Equation (3.2.8) is known as conditional version of Fama-French three-factor model with five pre-specified economic variables.

3.2.4 The performance analysis of MPF foreign equity funds

(1) Introduction

Although Hong Kong equity funds are the most common types of equity fund in the MPF schemes (33.33%, or 22 out of 66), a substantial portion of equity funds invest in equities traded in other developed stock markets, such as US, Asian countries, European countries, and Pacific Basin countries. To reduce the risks of the equity funds offered in the schemes, the MPFA does not allow the authorized fund investment managers to invest in emerging markets. Although international investment may reduce the unsystematic risk through cross-border diversification, international investing introduces an additional risk - exchange risk. The fluctuation in exchange rate between foreign currencies and the Hong Kong dollar which may either increase or decrease the portfolio returns. In particular, there is no conclusive evidence that an actively managed foreign equity fund outperforms a common benchmark portfolio that is passively managed, such as the Hang Seng Index or FTSE MPF Hong Kong Index.

(2) Modified Jensen model with control variable

Long-run changes in exchange rates reflect international differences in inflation rates and the purchasing power of each country's currency, such effect is called International Fisher Effect. According to the International Fisher Effect, the excess return from a foreign equity fund $(R_{i,t} - R_{f,t})$ may be generated by a regression model with one control variable which captures the changes in the exchange rate added, as follows:

$$R_{i,t} - R_{f,t} = \alpha + \beta_1 \cdot (R_{mf,t} - R_{f,t}) + \beta_2 \cdot R_{ex,t} + \beta_3 \cdot (R_{md,t} - R_{f,t}) \quad (3.2.9)$$

where $R_{ex,t}$ is the control variable added to capture the monthly changes in exchange rates which is compounded from daily changes. The daily changes are calculated by the difference of natural logarithm $\left[\ln\left(\frac{X_j}{X_{j-1}}\right)\right]$, where X_j is the amount of HK dollar that one can exchange for each unit of foreign currency at day j, $R_{mf,t}$ denotes the return on foreign country's market portfolio measured by the foreign currency unit and $R_{md,t}$ is the return on the Hong Kong market portfolio (the FTSE MPF Hong Kong Index).

The coefficients in the equation (3.2.9) may be interpreted as: (1) α measures the fund manager's stock selectivity ability; (2) β_1 measures the sensitivity of the fund returns to the foreign market returns; (3) β_2 measures if the changes in foreign exchange rate have significant effect on the fund return; and (4) β_3 measures the degree of market integration to the Hong Kong stock market. A statistically significant β_3 indicates the foreign country's stock market is segmented from the Hong Kong stock market and the foreign equity fund return is affected by the HK stock market return.

As some groups of equity funds may invest in several countries, the control variable R_{ex} will then be a weighted-average of the monthly returns of a group of foreign currencies, the criterion of using such currencies depends on the countries where the equity funds in that fund groups invest in. The use of currency in the weighting scheme for the following fund groups is as follows:

1. US equity funds (USEQ): US dollar
2. Japanese equity funds (JPEQ): Japanese Yen
3. Asia excluding Japan equity funds (ASEQ): Taiwan Dollar, Singapore Dollar, Thailand Baht, Malaysia Ringgit, and India Rupee.
4. Pacific-Basin excluding Japan equity funds (PBEQ): Taiwan Dollar, Singapore Dollar, Thailand Baht, Malaysia Ringgit, and India Rupee, Australia Dollar, and New Zealand Dollar.
5. European equity funds (EUEQ): Euro, British Pound, and Swiss Franc.
6. Global equity funds (GBEQ): US Dollar, Canadian Dollar, Japanese Yen, Taiwan Dollar, Singapore Dollar, Thailand Baht, Malaysia Ringgit, India Rupee, Australia Dollar, New Zealand Dollar, Euro, British Pound, and Swiss Franc.

3.2.5 The performance analysis of MPF index funds

The objective of an index fund is different from that of actively managed funds in that index funds aim to replicate the return and risk of the underlying benchmark index. If an index fund is not able to replicate the returns on a benchmark index perfectly, this fund is considered as unable to meet its investment objective. Roll (1992) suggests that the level of tracking error may be an important criterion to assess an index fund performance because the fund's differential return may investigate that if the manager's investment process has been implemented successfully, even in the case of non-indexed equity funds. Pope and Yadav (1994) also agree that the tracking errors are crucial in structuring and managing index funds.

Tracking error represents the difference between the performance of an index fund and that of its target index. Pope and Yadav (1994) suggest three different definitions of tracking error.

The first definition of tracking error is defined as the absolute difference in returns between the fund and the index, $TE_{AD,i}$. This definition provides a measure of the extent to which the returns on an index fund i differ from the returns on the underlying benchmark index b over the sample period, and treats any absolute deviation in returns as tracking error. This definition of tracking error is calculated as follows:

$$TE_{AD,i} = \frac{\sum_{t=1}^{n} \left| e_{i,t} \right|}{n} \tag{3.2.10}$$

where $e_{i,t} = R_{i,t} - R_{b,t}$ (3.2.10A)

$R_{b,t} =$ the return of the benchmark index b in period t, and

$n =$ the number of periods

The second way to measure the tracking error is by finding the annualized standard deviation of return differences between the index fund and the benchmark index, which is calculated as follows:

$$TE_{SD,i} = \left[\sqrt{\frac{1}{n-1} \sum_{t=1}^{n} \left(e_{i,t} - \bar{e}_i \right)^2 } \right] \sqrt{M} \tag{3.2.11}$$

where $M =$ the number of periods within a year, M will be 12 if monthly data are used.

Using annualized standard deviation to measure the tracking error requires the assumption of serially uncorrelated return differences, $e_{i,t}$. This definition may not be appropriate for daily data because the daily returns almost certainly be serially correlated. The other shortcoming of this definition is that if a fund consistently underperforms or outperforms the target index by same magnitude, the tracking error measured by the standard deviation may result in zero.

The single-index Jensen model may also be used to generate an estimate of tracking error $(TE_{CAPM,p})$. The standard error of the regression equation of the Jensen model, which is defined as $R_{i,t} = \alpha + \beta \cdot R_{b,t} + e_t$, can be interpreted as measure of the tracking error. However, Pope and Yadav (1994) point out two problems underlying in this measure. If the beta is not exactly equal to one, this measure may result in a value different from $TE_{SD,i}$; and the approach may overestimate the tracking error if the relationship in the Jensen model is not linear.

The magnitude of the tracking error may indicate: (1) how closely the index fund is tracking its target index; and (2) the size of the cost that routinely erodes the index fund returns.

3.3 Data

The data set consists of monthly prices of MPF constituent equity funds, from the date of the launch of MPF scheme on December 1, 2000 to December 31, 2004. All of these data were provided by Lipper Asia Limited[4]. The sample contains a total of 48 monthly observations. Most of previous studies suggested that using monthly or quarterly data for mutual fund performance studies is appropriate as the distribution of monthly or quarterly returns are closer to normal distribution of daily returns. According to the categories specified by Hong Kong Investment Fund Association (HKIFA), the sample equity funds are separated into Hong Kong Equity, US Equity, Asia Excluding Japan Equity, Japanese Equity, Pacific Basin Excluding Japan Equity, European Equity, and Global Equity. This study excludes the category "other equity", which includes only one Korean equity fund and there is no benchmark designed for this category. Separating the funds is important when using risk-adjusted alphas to measure the performance, because the risk-adjusted measures include different benchmarks for different fund types.

[4] www.lipperweb.com

It should be mentioned here that the mid-point NAV of equity fund is reduced by the exact amount of dividends or capital gain distributions paid to the shareholders. The monthly prices in the database have added the distributions back to the mid-point NAV of equity fund.

The total number of the funds in each category as at the end of each quarter during 2001 – 2004 is summarized in table 3.3.1. The number of equity funds in the dataset at the first quarter of the first year (2001) was only 42 and it is increased to 66 as at the end of 2004. Table 3.3.2 lists the names of trustees and investment managers which offer equity funds in their schemes; and the names of the equity funds that they offer.

One of the key issues to be considered for each analysis of mutual fund performance is the potential survivor bias. If all funds of the population being studied do not survive the entire study period, the data will include measures of the surviving funds only. Test results will thus be biased to some degree, depending upon the attrition rate of the population, toward the survivors. The survivorship bias is minimal in this study because the number of funds that did not survive constitutes a very small portion of all equity funds. The only bias is that, if any funds closed and did not merge with an existing fund, that fund would not have returns to be included for the year in which operations ceased. In fact, only one equity fund ceased operations was operated by the trustee which have ceased providing MPF services, Chamber CMG Choice. The data from this MPF trustee cannot be collected, so the funds provided by them are dropped from the database. Complete data were then assembled for all funds for which the data had been published during the four-year period of 2001-2004.

Continuously compounded monthly returns are computed for each fund by taking the natural logarithm of the change in monthly NAV for each month in the sample, i.e.:

$$R_{i,t} = \ln \frac{NAV_{i,t}}{NAV_{i,t-1}} \tag{3.3.1}$$

where $R_{i,t}$ is the return on fund i during the month t, $NAV_{i,t}$ is the net asset value of fund i at month t, and $NAV_{i,t-1}$ is the net asset value of fund i at month t-1. The natural logarithmic monthly returns are then compounded to create quarterly and annually cumulative returns under the assumption of reinvestment of all distributions such as dividends and are net of all expenses except front-end or redemption load charges.

Seven equally-weighted style portfolios of the funds are constructed according to the classification scheme specified by HKIFA. They are: (1) HKEQ, portfolio of Hong Kong Equity funds; (2) USEQ, portfolio of U.S. Equity funds; (3) ASEQ, portfolio of Asia Excluding Japan Equity funds, (4) JPEQ, portfolio of Japan Equity funds; (5) PBEQ, portfolio of Pacific-Basin Excluding Japan Equity funds; (6) EUEQ, portfolio of European Equity funds; and (7) GBEQ, portfolio of Global Equity funds.

Table 3.3.3 presents an overview of their performance in the period over 2001 – 2004, and shows that the funds in ASEQ category provide the highest average monthly return (1.2% per month) while the funds in the USEQ category perform the worst (-0.13% per month). Table 3.3.3 also shows that although the funds perform badly during the first year of operation (2001), most of the categories may have an average of positive raw returns between 2001 and 2004 except the category of U.S. equity. Table 3.3.4 presents the quarterly returns of equity funds as at consecutive quarters during 2001-2004. The effect of the 911 terror attack and that of outbreak of SARS in East-Asia and ASEAN countries are captured by the negative average quarterly returns in balanced and equity funds in the third quarter of 2001 and the first quarter of 2003. Table 3.3.5 presents their annual returns during 2001-2004. The annual returns reveal that most of the equity funds provide negative annual average returns in the first two years.

The models outlined in section 3.2 require the use of two proxy variables: a risk-free rate and a market index. The MPFA prescribed saving rates quoted by the Mandatory Provident Fund Scheme Authority was used as a proxy for the risk-free rate $\left(R_{f,t}\right)$. The MPFA preseribed saving rate is designed by MPFA as a proxy for the risk-free rate, thus it is a good proxy and a direct comparison with the risky returns. The other types of risk-free rates exist in Hong Kong financial markets such as the short-term Treasury bill of Hong Kong Government may also be an appropriate proxy but it is related to the MPF performances directly. The source of the quotes is from the official webpage of MPFA. As monthly returns are required, it is appropriate to convert the stated percent per annum to continuous monthly rates as follows:

$$R_{f,t} = \frac{\ln\left[1 + R_{annum,f,t}\right]}{12} \tag{3.3.2}$$

where $R_{annum,f,t}$ is the annual MPFA prescribed saving rates at month t.

Table 1.2.9 summarizes the classification of the constituent funds and their respective benchmarks specified by the Hong Kong Investment Funds Association. Seven benchmarks are used to evaluate the stock selection skill of the equity funds in seven different portfolios of equity funds. Choosing a suitable benchmark is critical in evaluating equity fund manager performance. The compounded monthly logarithmic returns on these benchmarks will then be used as the market returns $\left(R_{m,t}\right)$ in equations described in section 3.2. The benchmarks include the monthly returns on the following indices which are currency hedged back into Hong Kong dollars, as required to meet the regulations set by MPFA: (1) 90% FTSE MPF Hong Kong plus 10% HSBC Index for HKEQ portfolio; (2) FTSE MPF USA (35% HK$ Hedged) for USEQ portfolio; (3) FTSE MPF Asia Pacific ex Japan, AU and NZ for ASEQ portfolio; (4) FTSE MPF Japan (35% HK$ Hedged) for JPEQ portfolio; (5) FTSE MPF Asia Pacific ex Japan for PBEQ portfolio; (6) FTSE MPF Europe (35% HK$ Hedged) for EUEQ portfolio; and (7) FTSE MPF All-World (35% HK$ Hedged) for GBEQ portfolio. The performance of the benchmark should represent the performance that the investors would earn in the same class of securities. The data of the quotes of the series of these benchmark indices are obtained from the DataStream.

The conditional models described in section 3.2 include five additional variables that are used to proxy the public information. The third additional variable, $\left(DIV_{t-1}\right)$, represents the lagged dividend yield in the Hang Seng Index; the series of HSI dividend yield are provided by the HSI Services Ltd and obtained from its official webpage[5]. The fourth variable, $\left(TERM_{t-1}\right)$, which involves the series of both interest rates of HKMA Exchange Fund Note and HKMA Exchange Fund Bill, are provided by the Hong Kong Monetary Authority and obtained from the DataStream. The last additional variable, $\left(DEF_{t-1}\right)$, which uses the series of Moody's BAA-rated and AAA-rated corporate bond yields, are provided by the Moody's Investor Service.

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[5] www.hsi.com.hk

3.4 Empirical results

3.4.1 Performance of MPF equity funds

(1) Traditional Jensen measures

The study on performance using risk-adjusted measure is restricted to equity fund portfolios only. According to the classification scheme specified by HKIFA, the equity funds may be classified into seven groups and equally-weighted portfolios are formed accordingly as Hong Kong Equity, US Equity, Asia Pacific Excluding Japan Equity, Japan Equity, Pacific Basin Excluding Japan Equity, European Equity, and Global Equity. Table 3.4.1 summarizes the traditional Jensen measures. The results show that most of the equity fund groups overperform the market indices except USEQ portfolio (Jensen alpha is -0.002 or -0.2% with t-statistic -3.348) and PBEQ portfolio (-0.002 or -0.2% Jensen alpha with t-statistic -0.757). The latter portfolio, PBEQ, which is a portfolio of Pacific-Basin excluding Japan equity funds, provides positive average monthly returns (shown in table 3.3.1) but a negative Jensen measure after risk-adjustment with market index. Among the seven portfolios, the JPEQ portfolio provides the highest alpha and such value is consistently positive and statistically significant (0.003 or 0.3% with t-value 2.180). This shows that the fund managers of the Japan equity funds have superior stock selection skills compared with the fund managers in the other fund groups. Without risk-adjusting, the ASEQ portfolio provides the highest mean average monthly returns, 1.2% per month (shown in table 3.3.3), compared with the other fund groups. However, the portfolio of that fund group only provides 0.01 or 0.1% Jensen alpha, which is not the highest among the seven portfolios. This reveals that the funds in that group perform well due to good performance in the market where this fund group focuses on, but not because of the existence of stock-selection skills in the fund managers.

(2) Conditional Jensen measures

To determine if conditioning on public information has impact on performance evaluation, conditional approach is also employed to measure performance with Jensen models and the results of regression estimates for conditional version of Jensen model are summarized in table 3.4.2. Panel A of table 3.4.2 shows that two equity fund portfolios

USEQ and ASEQ have improvements in the average of alphas if conditional approach is employed (-0.2% to -0.1% and 0.1% to 0.2% respectively). On the other hand, the other portfolios have approximately same or even decreases in the values of alphas when conditional approach is employed; HKEQ (remains 0.2%); JPEQ (from 0.3% to 0.1%), PBEQ (-0.2% to -0.3%), EUEQ (0.2% to 0.1%), and GBEQ (remains 0.1%). It shows that the fund managers in these categories rationally respond to the public economic information and adjust their portfolios accordingly and the information variables may control for this.

The results in these portfolios contrast with that of Ferson and Schadt (1996) who find that the alphas become more positive when the conditional model is used. The authors find this to be the case for US mutual funds; and also show that when the covariance between the excess return on the market portfolio and conditional beta, $\text{cov}(R_{m,t} - R_{f,t}, b'_{2j}Z_t)$, is negative, the traditional Jensen measure will be negatively biased. Significant negative correlation between the conditional betas and the excess market return in the fund groups which have same or less average alpha values may not be found. This explains why the Jensen measures in these fund groups do not become more positive when conditional models are applied.

Table 3.4.2 reveals that the five predetermined conditional variables in this study provide additional information for explaining the dynamics in returns of MPF funds. The *F*-statistic for the significance of public information variables report that all the conditional models for respective equity fund portfolios and for all equity fund portfolio are significant at 5% level of significance. Tables 3.4.1 and 3.4.2 also present the measures of adjusted R^2 from the two traditional and conditional models respectively. The public information variables may provide additional explanatory power of 0.2% to 1.2%.

There is evidence that the individual public information variables are related to excess return of funds. Panel B of table 3.4.2 presents the conditional Jensen measures for portfolio including all equity funds. The regression output indicates that all five predetermined public information variables are significant at 5% significant level. Except for the lagged dividend yield on HSI (DIV_{t-1}), all the other information variables are even significant at 1% significance level. The results are somewhat different when the conditional models are employed to evaluate the performance of the funds in portfolios of different fund groups. For ASEQ portfolio, all public information variables except the lagged quality spread in the corporate bond market (DEF_{t-1}) are significant at 5% significance level. Three public information variables are significant at 10% level for HKEQ portfolio. For both USEQ and EUEQ portfolios, two public information variables are significant at 5% level. Only the January dummy variable is significant at 1% level for the GBEQ portfolio. The worst cases are found in the models for JPEQ and PBEQ portfolios, none of the information variables are significant even at 10% significance level. Our result contrasts with that of Ferson and Schadt (1996), who found usually the lagged dividend yield on stock market and lagged one-month risk-free Treasury bill are significant regardless of fund styles.

Conditional models are also employed to evaluate the Jensen measures for individual fund. Due to the short history of MPF scheme, the predetermined public information variables, on the other hand, become insignificant in most of the regression models. The only one variable that seems to be important in explaining returns is the January dummy (significant for 9 out of the 63 equity funds). The other variable that seems to be important is the lagged quality spread in the corporate bond market (6 out of the 63). However, the *F*-statistic of the conditional models for all individual equity funds cannot reject the hypothesis that the conditional models are significant at the 5% level of significance. The major rationale of this contradiction should be the existence of multicollinearity among the predetermined public information variables.

(3) Comparison of two measures

To test if the conditional Jensen measure of individual fund is significantly different from the traditional Jensen measure, parametric paired *t*-test and nonparametric Wilcoxon matched-pairs test are employed. Table 3.4.3 presents the results of both tests. The null hypothesis is that there is no significant difference between the traditional alphas and conditional alphas of individual funds, for portfolios of all funds and our seven respective equity fund portfolios. Both *t*-test and Wilcoxon *z*-test provide consistent results which suggest that for all individual funds the traditional alphas are not different from the conditional alphas. When the tests are separated into seven portfolios, both tests still suggest that there are no significant differences between the traditional and conditional alphas except the portfolio of ASEQ portfolio at 5% level.

To compare the distributions of traditional and conditional alphas, a binomial test is employed. The null hypothesis is that there is no significant difference between the proportions of positive traditional alpha and conditional alpha. The results are summarized in table 3.4.4. Panel A presents the binomial test of null hypothesis that the respective proportion of individual traditional alphas in portfolio of all funds and that of individual conditional alphas in all-fund portfolio equals to 0.5. The number of positive (>0.000) traditional alphas and conditional alphas are 37 (56%) and 38 (58%) respectively. This implies that incorporating public information into the performance measure, the distribution of the alphas shifts to the right, which is consistent with the finding in Ferson and Schadt (1996). Figure 3.4.1 presents the respective histogram for the distributions of traditional and conditional alphas. The histograms illustrate that the distributions shift to the right when conditional approach is employed, and the values of skewness coefficient also provide consistent conclusion (skewness coefficient changes from -0.41 to 0.215 when incorporating public information). The binomial test shows that both previous indicated proportions are found not to be significantly different from 50% (*p*-value is 0.389 and 0.215 for traditional and conditional alpha respectively). Ferson and Warther (1996) show that the conditional alphas will be higher than the traditional alphas when there is a positive correlation between expected market returns and the new money flow into mutual funds over time combined with a negative relation between new money flow and mutual fund betas. It is likely that the flow of MPF contributing monies and the cash holdings of these funds respond as much in the short run to expected market returns as in the case of mutual funds.

Panel B of table 3.4.4 presents the binomial test to null hypothesis that there is no difference between the distributions of traditional and conditional alphas. The asymptotic *z*-statistic provides a result consistent with paired *t*-test and Wilcoxon *z*-test on difference between the means of traditional alphas and conditional alphas. The binomial test shows that there is no significant difference in the distributions of traditional and conditional alphas for the portfolio of all funds.

Parametric ANOVA and nonparametric Kruskal-Wallis test are employed to test if the average traditional Jensen measures and conditional measures are same across seven portfolios of equity funds. The results are summarized in table 3.4.5. Both tests provide consistent conclusion that the average alphas measured by traditional measure and conditional measure are different across seven portfolios; where traditional alphas are found to be different among the fund groups at 10% level by parametric ANOVA but 5% by nonparametric approach. Conditional alphas are found to be different among fund styles at 1% level. The results are consistent with previous findings documented in the literature; funds with different investment objectives or styles produce significant different risk-adjusted returns.

3.4.2 Alternative performance

(1) Fama-French three-factor alpha measure

The result of the model estimates that the regression of the excess returns of the equity funds on the Fama-French three factors is summarized in table 3.4.6. The Fama-French three-factor model seems to have higher explanatory power than the traditional Jensen measure shown by higher values of adjusted R^2 (at most 0.5%) in all fund groups and the portfolio of all equity funds. The estimated numbers under the column α still indicate portfolios USEQ and PBEQ underperform the benchmark indices and the magnitudes are similar to the estimates from the traditional Jensen measure, although risk-adjusted by two additional factors *SMB* and *HML*. In sum, the inclusion of both factors *SMB* and *HML* does not affect the conclusion of underperformance of funds in portfolios of USEQ and PBEQ.

Paired-sample *t*-test is employed to test if the alpha measure run by the Fama-French three-factor model for individual fund is different from the alpha measure run by the traditional Jensen model for individual fund, and the result is summarized in table 3.4.7. The test result for all-fund portfolio indicates no significant difference between two different measures. When considering the separate fund portfolios, the test result shows that most of the fund groups do not exhibit significant different values for these two measures except USEQ and JPEQ, individual funds in the former portfolio show significant smaller Fama-French alphas; while those in the latter portfolio exhibit significant larger Fama-French alphas at 10% significance level.

The values in the column *s* of table 3.4.6 show that only the portfolios PBEQ and GBEQ have significant *SMB* coefficient at 10% significance level; and the regression results show that three portfolios USEQ, PBEQ and EUEQ exhibit negative *SMB* coefficient, which indicate the fund managers in these three fund groups are tilted toward large stocks. The coefficient *s* in the regression model run for the portfolio of all funds is positive, which implies the MPF equity fund managers on the average tend to invest in small stocks relative to the market.

The values of the regression coefficients of the mimicking factor *HML* are positioned in the column *h* of table 3.4.6. Negative and significant *h* at 10% significance level for all-fund portfolio points out that the fund managers on the average are tilted toward the low *B/M* stocks. Regarding the separate equity fund portfolios, the regression coefficients are negative for HKEQ, USEQ and ASEQ portfolios. That indicates the fund managers in these three fund groups have tendency on investing low *B/M* stocks; while the fund managers in the other four fund groups tend to invest high *B/M* stocks.

In conclusion, the evidence that Hong Kong MPF equity funds tilt toward small and glamour stocks may be found. All portfolios except JPEQ have positive t-statistic in the paired-sample *t*-test with result summarized in table 3.4.7; it implies that most of the funds have decrease in the performance when measured by the Fama-French three-factor measures and it implies that using traditional Jensen measure may result in spurious performance as the MPF equity fund managers tilted toward small stocks relative to the market.

(2) Conditional Fama-French three-factor model

The impact of public information variables on Fama-French three-factor model is evaluated by running the conditional version of Fama-French measure and the result of the regression estimates is summarized in table 3.4.8. The conditional version of Fama-French measure seems to improve the values of alpha than the unconditional version. Similar improvement is also found when the Jensen model is conditional on economic variables. When the conditional Fama-French measure is used, only one fund group of equity funds PBEQ exhibits underperforming the benchmark significantly; while the USEQ that exhibits underperforming the benchmark significantly in the previous model is shown underperform the benchmark slightly under the conditional version of Fama-French measure. Table 3.4.8 also shows that the public information variables may provide additional explanatory power given by higher value of adjusted R^2 ranges from 0.2% to 0.8%.

3.4.3 Exchange rate controlled performance of international equity funds

The result of the regression estimates of the exchange-rate controlled Jensen measure given by equation (3.2.14) of respective fund groups except HKEQ is summarized in table 3.4.9. Portfolios USEQ and PBEQ, which have been shown underperforming the market by traditional Jensen alpha measure, still exhibit underperforming the market shown by negative intercepts although controlled by exchange rate changes; and this implies that the inferior performance of the funds in these two portfolios are not due to exchange rate losses. Regarding the portfolio GBEQ, it shows positive Jensen alpha measure but negative alpha after being controlled by exchange rate changes. It implies that the traditional Jensen alpha measure which may result in spurious overperformance measures are mainly due to the exchange rate gains during the sample period. Besides GBEQ, JPEQ and EUEQ portfolios also have decreases in values of alpha measures after being controlled by exchange rate changes; it implies a portion of the performance of the funds in these portfolios may be due to the exchange rate gains in the sample period.

All groups of equity funds show significant positive β_1 coefficients, which indicates the foreign country's markets are statistically significant in explaining the equity fund returns. Among the six fund groups, two groups USEQ and JPEQ exhibit the value of β_1 larger than one, which implies that the US equity funds and Japanese equity fund may generate higher returns than those provided by the benchmark indices. The finding of more-than-one β_1 in these two fund groups is consistent with that found by traditional Jensen measure.

Whether the changes of exchange rate have effect on the returns of non-HK equity funds is the other focus in this section. When the coefficients β_2 are evaluated for their significance, only three out of six fund groups have significant estimates at 1% significance level and one group exhibits significant estimate at 10% level of significance.

The insignificant regression coefficients β_2 in two fund groups, USEQ and PBEQ, may be interpreted as the exchange rates I n general do not have effect on the returns of the equity funds in these two groups (for instance, the returns of US equity funds should not be influenced by the changes in the exchange rate between HKD and USD due to the pegged system implemented since 1984) or the effect of exchange rate changes has been included in the returns.

The final coefficient β_3 measures the degree of market integration to the Hong Kong stock market. The results show that larger portion of fund groups (four out of six) exhibit insignificant β_3 even at 10% significance level. This implies that the non-HK equity fund returns are not affected by the movements in Hong Kong equity market.

3.4.4 Tracking performance of MPF index funds

Table 3.3.2 lists all the equity funds offered in all MPF schemes. Among the 66 equity funds offered, four are index funds. They are:

1. HSBC MPF – Supertrust – Hang Seng Index Tracking Fund;
2. HSBC MPF – Supertrust Plus – Hang Seng Index Tracking Fund;
3. Hang Seng MPF – Supertrust – Hang Seng Index Tracking Fund; and
4. Hang Seng MPF – Supertrust Plus – Hang Seng Index Tracking Fund.

The magnitude of tracking errors of the four index funds is summarized in table 3.4.10. Panels A, B and C of the table present the tracking error using different definitions – average of absolute return differences $(TE_{AD,i})$, annualized standard deviation of return differences $(TE_{SD,i})$, and standard error of regression of CAPM model $(TE_{CAPM,p})$, respectively. The tracking error based on $TE_{AD,i}$ is shown to be 0.0033. The tracking error based on $TE_{SD,i}$ shows a value of 0.0155. The last tracking error based on $TE_{CAPM,p}$ gives a similar figure of 0.0110. The tracking error of MPF equity index funds are found to be relatively higher than those documented previously (Frino and Gallagher (2001, and 2002)), it shows evidence that the MPF equity index funds seem not achieve the target index returns. This shows that the equity funds may incur higher trading costs or the index funds have maintained large amount of cash in their portfolios for redemption.

It is interesting to note that in panel B, the mean return difference is found to be positive which implies that the MPF equity index funds seem on the average outperforming their target index, Hang Seng Index. However, the statistical test employed to test the null hypothesizes that the absolute return differences and raw return differences are not significantly different from zero should be rejected. It indicates significant clear evidence that the index funds difficult to replicate the returns of the Hang Seng Index over the period 2001-2004.

Figure 3.4.2 exhibits the graphs which show the trend of average tracking error based on the absolute difference between the returns of index funds and benchmark index $\left(\left|e_{i,t}\right|\right)$, and that takes the raw differences $\left(e_{i,t}\right)$ as the definition, respectively for every calendar month. Both graphs consistently show significant evidence that the tracking error is relatively higher in March, and relatively lower in February and June. One of the explanations of relatively high tracking error in March is that most of the blue chip companies in Hong Kong announce their annual performance of previous year and declare the amounts of distribution of dividends in March. The delay in the receipt of dividends from the Hang Seng Index constituent companies may make the equity index funds difficult to replicate the returns of Hang Seng Index and consequently result in sharp increase in tracking error. The correlation coefficients between the return differences and the dividend yield in HSI are also found to be positive, which implies the existence of positive relationship between the dividend payment and the relatively higher tracking error.

To further analyze the seasonality of the tracking error statistically, a regression with month-of-the-year dummy variables, February-December, will be used to test whether the tracking error is different from some months than others and is given as:

$$\left|e_{i,t}\right| = \alpha + \sum_{j=2}^{12} b_j D_j + \varepsilon_i \tag{3.4.1}$$

$$e_{i,t} = \alpha + \sum_{j=2}^{12} b_j D_j + \varepsilon_i \tag{3.4.2}$$

where $e_{i,t} = R_{i,t} - R_{b,t}$, the difference between the index fund and HSI returns (3.2.12a)

α is the intercept which indicates the absolute difference and difference in January

D_j is the month dummy variable where j = 1 (February) to 11 (December)

The existence of seasonality effect may be detected by the significant F-statistic which tests the null hypothesis that the independent variables are jointly insignificant against the alternative hypothesis that not all independent variables are insignificant.

The results of the regression analyses are summarized in table 3.4.11. The results clearly indicate evidence that the tracking errors measured by either absolute differences or raw differences have significant regression coefficient on dummy variables "March" at 1% significance level, which further indicates the seasonal pattern exists in the tracking error for every calendar month March during the observation period.

Besides the timing delay in receipt of dividend may increase the size of tracking error, the index composition changes, fund cash flows, and index volatility, transaction costs of the equity index funds may also be the factors that increase the tracking error.

During the observation period, the HSI Services Ltd has changed the index constituent stocks for five times. The HSI Services usually pre-announce such information several weeks before the effective date. The index funds may change their portfolios continuously after the announcements made. As the HSI Services Ltd does not change the index constituents during the same month every year, it makes the index composition changes seem not to influence the monthly pattern of tracking error.

The other relatively higher tracking error in August may be due to higher cash inflow into MPF equity funds injected by the fresh graduates who enter the workforce in July and start their MPF contribution in August. The fresh graduates have preferences on equity index funds because they have little investment experience, thus prefer passively managed funds rather than actively managed ones.

3.5 Conclusions

The performance of Hong Kong MPF equity funds has been investigated in this chapter. The results of the study provide good news for Hong Kong workforces who are required to contribute MPF and choose equity funds as their core funds. Without adjusting for risk, only the group of US equity funds was found to exhibit negative mean monthly return over the observation period January 2001 – December 2004; while the other fund groups were found to have positive mean monthly return. The quarterly performance analysis shows that the performance of equity funds were also influenced by the 911 terror attack and the outbreak of SARS in Hong Kong and ASEAN countries. Annual performance analysis indicates clear evidence that the performance of MPF equity funds become better in the latter half of observation period, years 2003 and 2004.

As the returns were risk-adjusted, the equal-weighted portfolios of the 66 equity funds run by 21 different investment managers under supervision of 14 trustees outperform the single-index benchmark by approximately 0.1%. The subset of funds performed worse. The US equity funds and the Pacific-Basin excluding Japan equity funds were found underperformed the benchmark by approximately 0.2% respectively. The Japanese equity funds, on the average, may provide the highest risk-adjusted figures. The parametric ANOVA test indicates that the magnitudes of alphas are different among different fund styles.

This chapter also examined the effect of incorporating public economic information including lagged MPFA prescribed saving rate, January effect, lagged dividend yield, lagged term spread, and lagged quality spread, in order to evaluate the MPF equity fund performance. The employed public information variables are all statistically significant at 5% and have explanatory power as they may increase the value of adjusted R^2. Although the conditional Jensen measure gives smaller average conditional alphas for the portfolios, the conditional Jensen measure may improve the performance of individual MPF equity funds, not only increase the magnitude of alpha, but also cause higher proportion of funds with positive alphas and shift the distribution of alphas to the right with the evidence of large skewness coefficient. However, no significant difference between the proportions of funds with positive alphas was found to be indicated by asymptotic z-statistics. Besides no significant difference between the distributions of positive traditional and conditional alphas, t-test and Wilcoxon z-test consistently indicate that the average conditional alpha of all equity funds is not significantly higher than the average traditional alpha.

Several groups of equity funds were found exhibiting insignificant decrease in alpha as public information variables were incorporated; these include Hong Kong equity funds, Japanese equity funds, Pacific-Basin excluding Japan equity funds, and European equity funds. It shows that the fund managers in these categories rationally respond to the public economic information and adjust their portfolios accordingly. Ferson and Schadt (1996) show that the significant negative covariance between the conditional beta and the excess return on the market portfolio, $\mathrm{cov}(R_{m,t} - R_{f,t}, b'_{2j}Z_t)$, may make the conditional alpha significantly larger than the traditional alpha. This study finds that the fund groups which exhibit larger conditional alpha measures possess positive $\mathrm{cov}(R_{m,t} - R_{f,t}, b'_{2j}Z_t)$.

This study is also the first one to employ the Fama-French three-factor measure to evaluate the performance of MPF equity funds. The performance of the equity funds are adjusted not only by the excess market return but also two additional factors which mimic the risk factors related to size and value factors of the constituent stocks in the FTSE Hong Kong MPF Index. The Fama-French measures still indicate the US equity funds and Pacific-Basin excluding Japan equity funds underperform their benchmark indices. The sign of regression coefficients of the additional risk factors implies that the equity fund managers are generally tilted toward small and glamour stocks. Statistical test indicates the values of the intercept (alphas) are not significantly different in the traditional Jensen model and the Fama-French three-factor model. The comparison of the magnitudes of Jensen alpha measure and Fama-French three-factor alpha measure indicates that average former measure (Jensen) is generally higher than the latter one (Fama-French) and implies the Jensen measure may result in spurious performance because the equity fund managers generally are tilted toward small stocks.

The modified Jensen measure which extends the traditional Jensen measure by adding an additional control variable, changes in exchange rate, was used to evaluate the performance of non-Hong Kong equity funds. The US equity and Pacific Basin excluding Japan equity funds still exhibit underperforming their benchmark index after controlled by exchange rate changes. The European equity, Japanese equity and Global equity funds were found that a portion of their performance may be due to the exchange rate gains. The focus of the exchange-rate-controlled measure is to see if the exchange rate changes have effect on the performance of non-Hong Kong equity funds. The findings indicate that except the US equity funds and Pacific-Basin excluding Japan equity funds, the performance of non-Hong Kong equity funds seems to be affected by the changes of the exchange rates.

This chapter is also the first study to evaluate the ability of the index fund component in the MPF schemes to exactly replicate the returns of the target index – Hang Seng Index. The four index funds included in the schemes were found difficult to achieve returns approximately equal to the target index returns as statistical test indicated the tracking error, regardless of which definition, is significantly different from zero. It is interesting that the mean raw difference between the index fund returns and target index return is positive, on the basis of this research, the HSI index funds seem to earn a relatively higher return than its target index. Evidence of seasonality was found inherent in the tracking errors. The tracking errors according to different definitions are significantly higher in March when most of the HSI constituent stocks announce their previous year performance, and the amount and the way of dividend payments. The seasonal pattern was also diagnosed by a regression model which used eleven indicators (dummy variables) to represent twelve calendar months.

The comparison of the returns of actively managed funds and index funds suggest that not only the actively managed HK equity funds but also the HSI tracking funds may outperform their benchmark index during the observation period.

In conclusion, this chapter demonstrates how capable the MPF equity fund managers are at security analysis in the effort to make the MPF scheme participants wealthier. Summarizing all different measures used in this chapter, it suggested that the US equity and Pacific Basin excluding Japan equity funds perform the worst even controlled by the changes in exchange rate.

CHAPTER 4 PERFORMANCE PERSISTENCE OF MPF EQUITY FUNDS

4.1 Introduction

The predictability of the performance of securities including recognized funds has long been of interest to academics. Although most of the MPF funds have negative returns in the first two years of operations, active managers still try to outperform each other and the market. Historic alphas indicate the existence of past average abnormal performance. Of great interest is whether there is persistence in performance. For theorists and participants, understanding performance persistence is important. For the theorists, the existence of performance persistence indicates the market is not efficient. For the participants, especially most of whom have no investment experience and knowledge, the strategy of whether buying last-years winner is good or not will be the interest to them. As the MPF participants may change their fund managers, the usefulness of track records is taken for granted by most participants.

Mutual fund performance persistence is substantially documented in finance literature (section 2.4) but these previous studies found mixed evidences on short-term persistence in mutual fund performance in US. Early studies of mutual fund performance persistence have generally suggested that there is little information in the performance track record. However, more recent studies find that when a shorter evaluation period is used, past performance does provide information about future performance of funds. They document that there exist funds exhibit short-term persistence in returns and suggest that investors can earn abnormal returns by pursuing certain investment strategies to exploit this information. Compared with literature on mutual funds in U.S. and Europe, no research has been conducted on the performance persistence of Hong Kong MPF so far. More precisely, this chapter aims at answering the following questions.

Firstly, do some Hong Kong MPF equity funds systematically outperform their peers? The usual methods employed to detect evidence of return persistence consist of two streams: parametric method that involves using regression model of current-period performance measures on last-period performance measures and nonparametric method that refers to constructing contingency tables.

Two different approaches to return persistence analysis are undertaken in this chapter. The first approach follows Goetzmann and Ibbotson (1994), the nonparametric approach to detect persistence of performance by constructing two-way tables showing successive performance over time. The second approach is to follow the parametric approach, which detect the persistence by running regressions of the current period performance on the subsequent period performance. The strength of the persistence of performance may be evaluated by testing the significance of the regression coefficients.

Secondly, whether the MPF constituent funds display risk-adjusted performance persistence is examined. Indeed, one would like to know if some managers can consistently generate superior performance after accounting for their systematic risk exposures. In order to address this issue, the Jensen alpha measure is used as performance measure and their persistence will also be determined using the same parametric and nonparametric methodologies described above.

Thirdly, some further analyses of the performance persistence are also done. The relation between the fund volatility and performance persistence is examined by separating the equity funds into two batches – high-volatile and low-volatile funds, the evidences of performance persistence are then examined separately in these two clusters of funds.

Fourthly, to maximize the number of independent time periods, the quarterly and semi-annually performance persistence will be studied.

Fifthly, the evidences of performance persistence of different groups of equity funds will be studied by separating the funds into seven portfolios

Lastly, the performance persistence of the funds provided by each investment manager is examined. The rationale of performing this analysis is that the funds under the same investment manager may share same slot of supports and resources, and are under the same supervision.

The remainder of this chapter is organized as follows. Section 4.2 outlines the nonparametric and parametric research methodologies used to determine the return persistence. Section 4.3 discusses the data set used in the study. Section 4.4 presents the empirical results of evidences of raw- and risk-adjusted return persistence by nonparametric approach and parametric approach and the result of evidences of persistence in the rankings of the fund performance. Section 4.5 provides some further analysis of performance persistence such as the relation between fund volatility and performance persistence, the evidences of performance persistence of different groups of MPF equity funds, and the evidence of performance persistence of constituent funds provided by same investment manager. Section 4.6 provides a conclusion of this chapter.

4.2 Research methodology

4.2.1 Nonparametric approach to identify performance persistence

The first investigation of persistence uses the contingency table which is named "winner-winner, winner-loser" methodology applied by Goetzmann and Ibbotson (1994), the persistence of performance measured by absolute returns will be analyzed by constructing two-way tables showing performance over successive periods. The use of contingency table is referred to as non-parametric approach. As opposed to parametric approach, non-parametric approach is used to estimate percentiles of any continuous distribution without the shape of the distribution being specifically defined by a formula and thus robust when the normality assumption does not hold.

Following Goetzmann and Ibbotson, the fund is defined as a winner in the current period if the raw return is above or equal to the median returns of all MPF equity funds over the stated holding period. In other words, the winners (denoted by *W*) are distinguished from losers by ranking fund performance and defining the top half of the list as winners and the bottom half as losers (denoted by *L*). Funds with returns equal to the median are also called "winners". If a fund is in *W* for consecutive periods, it is defined as a winner-winner (*WW*). Thus, winner-winner (*WW*) for 2002-2003 is the count of the winners in 2002 that were also winners in 2003 if annual returns are being used to evaluate the performance. If a fund remains in the bottom half of the returns for two consecutive years, it is a loser-loser (*LL*). A fund that shifts from W to L is a winner-loser (*WL*) and a fund that shifts from L to W is a loser-winner (*LW*). The frequencies inside are the numbers of funds that are belong to one of four categories: (1): $W_t W_{t+1}$, (2) $L_t L_{t+1}$, (3) $W_t L_{t+1}$, and (4) $L_t W_{t+1}$. Funds in the first two categories are defined as persistent winner (loser) funds. The last two categories are defined as winner then loser, and loser then winner. The two-way contingency tables will be constructed as follows:

		Period t+1	
		Winner (*W*)	Loser (*L*)
Period t	Winner (*W*)	*WW*	*WL*
	Loser (*L*)	*LW*	*LL*

To the interest of the scheme participants, analyzing the annual performance persistence is important to them as most of the scheme participants change and reallocate their fund portfolios inside their plans every year, especially at the beginning of calendar year. The participants who change their portfolios every year mostly check the previous annually performance of the constituent funds in their portfolios and reallocate their portfolios based on the previous performance.

The significance of evidence of performance persistence may be investigated by some statistical tests. The first one is the binomial test, or named as Malkiel z-test. This test detects if statistically there is evidence showing that winners (losers) in the period t have a significantly greater than 50% chance of remaining winners (losers) in period t+1 exists. The test statistic is computed as follows:

$$Z = \frac{X - np}{\sqrt{np(1-p)}} \tag{4.2.1}$$

where X is the number of persistently winning (or losing) funds; n is the number of funds in the sample; and $p = \frac{1}{2}$ which is the probability that a winning fund remaining in the winning category.

The other test that may investigate the statistical significance of the performance persistence is the cross-product ratio (CPR) test. CPR is defined as $\frac{WW \times LL}{WL \times LW}$, which captures the ratio of the funds that show performance persistence equals to one or not. The null hypothesis of no evidences of performance persistence is tested by hypothesizing CPR equals to one, in other words, each of the four categories denoted by *WW*, *WL*, *LW*, and *LL* is expected to have 25% of the total number of funds. In large samples with independent observations, the standard error of the natural log of the odds ratio is well approximated as $\sigma_{\ln(CPR)} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}}$ in Christensen (1990). The test statistic is the natural logarithm of odds ratio divided by its standard error, and is asymptotically normally distributed under the assumption of independence of the observations.

$$Z = \frac{\ln(CPR)}{\sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}}} \tag{4.2.2}$$

The last test that may also investigate the significance of performance persistence is the Chi-square independence test. Carpenter and Lynch (1999) find that the Chi-square independent test based on the number of winners and losers is well specified when they study the specification and power of various persistence tests. The rationale of the test is that because half of the funds are defined as winners and losers respectively, if the evidence of persistence does not exist, the numbers in each bin should be equal or the actual distribution in each bin should be 25% of the total number of funds. On the other hand, the frequencies in the diagonal bins will be statistically significantly higher than the other two bins if performance persistence exists. The null hypothesis of no evidence of performance persistence against the alternative of existence of persistence is diagnosed by χ^2 which follows a chi-square distribution with $(R-1)\times(C-1)$ degree of freedom in an R by C contingency table, so the degree of freedom in the tests of this chapter is one. The test statistics is defined as

$$\chi^2 = \frac{(WW - E_1)^2}{E_1} + \frac{(WL - E_2)^2}{E_2} + \frac{(LW - E_3)^2}{E_3} + \frac{(LL - E_4)^2}{E_4} \tag{4.2.3}$$

where E are known as expected values in the Chi-square test, and

$$E_1 = \frac{(WW + WL)\times(WW + LW)}{n};\ E_2 = \frac{(WW + WL)\times(WL + LL)}{n}$$

$$E_3 = \frac{(LW + LL)\times(WW + LW)}{n};\ E_4 = \frac{(LW + LL)\times(WL + LL)}{n}.$$

If a 5% level of significance is taken, the corresponding critical value of a Chi-square statistic with one degree of freedom will be 3.841.

The cross-product ratio test and chi-square test usually lead to the same conclusions about performance persistence. However, the latter has the disadvantage of not being able to find evidence of performance reversal since it is always positive; while the former may detect evidence of performance reversal with a negative z-statistic.

The usual practice in fund rating companies for identifying a winner is to require a suitable longer evaluation period as statistical noise may mask the short-term performance. The performance persistence over successive one-year intervals is first under study. The performance for the first operating year 2001 is used to predict the performance for the subsequent one year 2002. Besides the annual horizon, quarterly and semi-annually performance evaluation holding period is also going to be studied. Inclusion of less-than-one-year time periods may maximize the number of independent time periods. Large number of independent separate persistence analysis may provide the most unambiguous statistical evidence supporting the repeat-winner hypothesis although the short-time-period result is much noisier. Moreover, previous researches show that the evidence of performance persistence is time-dependent. Using different time-horizons will conjecture whether the performance persistence in MPF is dependent on the holding period, and will yield information regarding the duration of the performance persistence. Based on the four-year dataset, the quarterly evaluation period generates fifteen successive quarter-lag periods. The six-month evaluation period yields seven successive semiannual-lag periods.

4.2.2 Parametric approach to identify performance persistence

The parametric approach to identify performance persistence is to compare the relation between the performance in the first evaluation period and that in the subsequent period, referred to as the holding period. The testing procedure is divided into two steps:

1. The performance may include raw absolute returns, and risk-adjusted returns measured by traditional Jensen alphas, conditional Jensen alphas, and Fama-French three-factor alphas. For the one-year time span, the performance is evaluated for the

first one-year-time-span evaluation period 2001 and for the corresponding one-year-time-span holding period 2002. Repeat the procedure until the last evaluation period that is over the calendar year of 2003 and the last holding period that covers the last calendar year of 2004. A total of three pairs of evaluation and holding periods are created.

2. An OLS regression that regresses the performance in the holding period (period t+1) on the performance measured in the evaluation period (period t) is used to investigate the performance persistence as follow:

$$PERF_{i,t+1} = a + b \cdot PERF_{i,t} + e_i \tag{4.2.4}$$

where $PERF_{i,t+1}$ is the fund i's performance for the t+1st holding period; $PERF_{i,t}$ is the fund i's return for the tth period; b is the slope coefficient measuring performance persistence; and e_t is the random error term.

A significant regression coefficient b indicates that there is strong association between the past performance and future performance, in other words, existence of performance persistence.

Similar to the nonparametric analysis by contingency table, quarterly and semi-annually performance persistence are also studied in the parametric regression analysis. In some previous studies, Goetzmann and Ibbotson (1994) used one- and two-year time spans, Blake, Elton, and Gruber (1993) used three-year time spans.

4.2.3 Persistence in performance ranks

To supplement the results obtained by the nonparametric contingency approach and parametric regression approach, Spearman rank correlation coefficient $(SRCC, r_s)$ is also employed to detect the evidence of persistence in performance ranks. This correlation coefficient provides a measure of correlation between ranks which are based upon absolute rank in the annual period. The returns are ranked from 1 to n, where n is the number of funds with annual return in the corresponding year, and the rank 1 is the lowest and n is the highest. The following equation provides a good approximation to r_s the number of ties is small relative to the number of pairs:

$$r_s = 1 - \frac{6\sum d_i^2}{n\left(n^2 - 1\right)} \tag{4.2.5}$$

where d_i is the difference in the return ranks of the ith fund for current year and subsequent year. The value of r_s falls between –1 and +1, with $r_x = +1$ indicating perfect positive correlation and $r_x = -1$ indicating perfect negative correlation. r_s falls closer to +1 and –1, greater the correlation between the ranks. Conversely, nearer to 0, the less the correlation.

Following Vos, Brown and Christie (1995), the correlation coefficient r_s computed for each year during the entire sample period is then averaged and the variance of the coefficient may be obtained by:

$$\mathrm{var}\left(r_s\right) = \frac{1}{n-1} \tag{4.2.6}$$

4.2.4 Risk-adjusted return persistence

Prior research showed that the evidence of return persistence is not affected by the risk adjustment (Goetzmann and Ibbotson, 1994; Brown and Goetzmann, 1995; Gruber, 1996). To test the hypothesis that the performance persistence pattern in our dataset is not influenced by the risk adjustment, this study uses not only the raw returns but also the single-factor Jensen alpha and Fama-French three-factor Jensen alpha as measures of performance of equity funds. The other rationale of adjusting risk is to document the differential expected returns between high-risk versus low-risk funds.

The procedures to find Jensen measure is outlined in equation (3.2.1). Since the Jensen measure has been adjusted for risks and is a standard measurement of fund performance, persistence in Jensen measures may be considered as due to the existence of consistent stock selection skills.

Sawicki and Ong (2000) suggest that further study may be done on the performance persistence using the conditional models as no studies have been done on whether the extreme performers may be more easily detected using conditional methods. This study will try to examine if there are evidences of persistence of performance measured by conditional Jensen measure and whether there is difference in the persistence pattern between traditional Jensen measure and conditional Jensen measure.

4.3 Data

All the analyses of this chapter use the same dataset as in chapter 3. The details of the description of the dataset are presented in section 3.3.

4.4 Empirical results of performance persistence

4.4.1 Nonparametric contingency tables

Tables 4.4.1 to 4.4.4 present the results of persistence tests by nonparametric approaches. Three statistical tests are employed to test the significance of the persistence. They are Malkiel z-test, cross product ratio test and Chi-square test. The Malkiel z-test separately compares if the percentage of winner-winner (*WW*) category is significantly higher than 0.5 compared with winner-loser (*WL*) category and if the percentage of loser-loser (LL) category is significantly higher than 0.5 compared with LW category. The cross product ratio test and Chi-square test take account of all four categories in the test statistic at the same time. If the persistence effect is strong and significant, the results of the cross product ratio test and Chi-square test should be consistent.

Table 4.4.1 presents the contingency table test for persistence in successive annual raw returns of MPF equity funds. Panel B indicates 72.37% of all winners in the current year are winners in the subsequent year. The Malkiel z-test indicates the percentages repeat of winner equity funds are significantly higher than 50% at 1% significant level. Regarding the “cold hand” phenomenon - repeating losers - casually suggested by Malkiel (1995), panel B indicates 68.92% of all losers repeat to be losers in the subsequent year and the Malkiel z-test indicates the hypothesis of repeating-losers is not rejected. The cross product ratio test and Chi-square test consistently indicate significant persistences in annual raw returns at 1% significance level, regardless of “hot-hand” or “cold-hand” phenomena. Considering consecutive annual periods individually, panel A of table 4.4.1 shows more significant evidences of performance persistence exist in the more recent two periods 2002 – 2003, and 2003 – 2004. The equity funds also have performance persistence in the first period 2001 – 2002 but not significant. Confirmed by cross product ratio test and chi-square test with insignificant statistics of 1.5342 and 2.4027 respectively. No reversal pattern, which is indicated by percentage of repeat winning funds less than 50% and repeating losers less than 50%, can be observed in all periods.

Two-way contingency table is also constructed based on single-factor Jensen measures which take account of risk to adjust the returns. Table 4.4.2 shows the result of analogous persistence test on successive annual Jensen measures. Panel B of table 4.4.2 indicates that the combined results still exhibit significant evidence of performance persistence suggested by consistent results of both cross product ratio test and chi-square test. The Malkiel z-test suggests both the percentages of repeat winning funds and repeat losing funds are significantly greater than 50%. However, both percentages of repeat winners and repeat losers are lower than those in previous table. Considering consecutive years individually, interestingly, the funds show significant performance persistence at 5% level if the performance is measured by risk-adjusted returns in 2001-2002 period. Consistent with the test on persistence of raw returns, significant performance persistence phenomenon occurs in the periods 2002-2003 and 2003-2004. However, the evidences of persistence in these two periods are weaker as the returns are adjusted by risks. The pattern of persistence appears to be not affected by the risk adjustment. The different systematic risk across the fund managers estimated by the single-factor Jensen model is not great.

Table 4.4.3 presents the analogous two-way table for evaluating persistence in conditional Jensen measure and indicates that the persistence effect becomes weaker as the performance measure is conditional on public information variables, shown by fewer repeat-winners and repeat-losers percentages and smaller value of z-statistics on repeat winners and repeat losers (2.3627 and 2.2549 compared with 2.5236 and 2.3250 respectively) and chi-square statistics (10.6420 compared with 11.7492). One of the individual one-year periods, 2002-2003, even becomes not exhibiting significant evidences of persistence.

The evaluation of evidences of persistence in performance measured by Fama-French three-factor alpha measure is summarized in table 4.4.4, which indicates that the evidence of performance persistence does not change but the effect becomes weaker than those using traditional and conditional alpha measures as performance measures. Panel A of the table indicates none of the individual one-year periods has significant persistence evidence; while panel B also indicates that the evidence of persistence is not significant for combined result.

4.4.2 Parametric regression analysis

Tables 4.4.5 to 4.4.8 present the results of persistence tests by parametric approaches. Table 4.4.5 presents the regression results for evaluating performance persistence in annual raw returns; tables 4.4.6 to 4.4.8 provide the results of analogous analysis for annual traditional Jensen measures, annual conditional Jensen measures and annual Fama-French three-factor measures.

The combined regression estimates for all one-year intervals are summarized in panel B of table 4.4.5. Consistent with using nonparametric approach, evidence of performance persistence is found as the regression coefficient is positive. However, the evidence of performance persistence is weaker when parametric approach is employed. The combined regression estimates provide a positive value of persistence coefficient of 0.112 with *t*-statistic of 1.641 with *p*-value of 0.100. The *p*-value of the performance persistence coefficient is slightly greater than 10% (10.003%). The individual regression estimates of persistence phenomena in each one-year interval summarized in panel A of the same table, which indicate stronger evidences of performance persistence with all 3 periods, exhibit positive and significant persistence coefficients. Comparing two different approaches, an interesting phenomenon that regression-based parametric test may provide a greater extent of persistence if separate analysis is done annually than the nonparametric test using contingency table is found in this study. This finding is consistent with that documented in literatures (Agarwal and Naik (2000)).

Like the nonparametric test, the parametric regression analysis is also performed for successive annual traditional Jensen alphas. The regression results shown in table 4.4.6 provide persistence patterns consistent with that found by contingency table shown in table 4.4.2. Panel A of table 4.4.6 shows positive slope of coefficients for all one-year intervals. Yet the evidence of performance persistence is not significant in the first period 2001-2002, with insignificant *t*-statistics 1.294. The combined regression results exhibit significant performance persistence. If panel B of table 4.4.6 is compared with that of table 4.4.5, stronger and more significant evidence of persistence is found after adjustment for risk.

The parametric regression analysis is also employed to evaluate the Jensen measure conditional on public economic information and the results for all one-year periods and individual one-year period are summarized in table 4.4.7. Similar to nonparametric analysis by contingency table, the parametric test indicates weaker evidence of performance persistence if the Jensen measure is conditional on public information; less significance of the regression coefficient is shown by higher value of t-statistics. Regarding the consecutive one-year intervals, one more one-year interval shows insignificant evidence of persistence. Not only the interval 2001-2002 but also the interval 2002-2003 has insignificant persistence coefficient.

Table 4.4.8 presents the parametric regression results for evaluating persistence evidence in performance measured by Fama-French three-factor alpha measures. Regarding the combined results in panel B, it is consistent with the findings in nonparametric two-way table approach, the evidence of persistence is still found but the effect becomes weaker shown by a smaller t-statistic. Regarding the evaluation of performance persistence for consecutive individual one-year intervals, there is only one annual interval 2002-2003 exhibits significant performance persistence.

Conclusively, both nonparametric and parametric approaches indicate most annual winners and losers repeat, occasionally there is no such effect, especially in the period 2001-2002. Previous studies suggest two major possibilities of such phenomenon. Brown and Goetzmann (1995) suggest that the existence of correlation in persistence which is due to individual fund managers selecting stocks that are overlooked or ignored by the other managers may be the first major possibility. The repeat winning could be due to a group phenomenon. Grinblatt, Titman and Wermers (1995) and Connor and Korajczyk (1991) also find the evidence of correlations in persistence. The other reason is the failure to discipline underperformers by the market, which makes the sample include some losing funds. During the sample period 2001 – 2004, there were no losing funds disappeared or were merged with the existing funds. It seems that the sample used in this study does not eliminate all losing funds.

The existence of significant evidences of persistence in the performance of MPF equity funds implies two types of participants exist in the schemes: 1) superior participants who thoroughly read the quarter or annual performance report published by the scheme trustees and thus possess superior information; and 2) momentum participants who change their investment from past losers to past winners. Grinblatt and Titman (1989 and 1993) cite these two types of investors contribute to the positive performance of mutual funds.

4.4.3 Persistence in return rankings

The Spearman Rank Correlation Coefficients computed to detect the evidences of annual raw return ranking persistences are summarized in table 4.4.9. Considering the consecutive individual annual period separately, the positive correlation coefficient indicates that all individual one-year-lag periods have evidence of significant persistence in raw return rankings. The mean correlation coefficient is 0.541, which is computed with a standard deviation of 0.181. The positive mean coefficient indicates evidences of persistence in raw return ranking over the entire sample period 2001-2004 and implies that the winners in the current year have higher possibility of being winners in the subsequent year. Relatively small standard deviation reveals substantial amount of stability.

Analogous Spearman rank correlation coefficients computed for finding evidences of risk-adjusted return ranking persistence are exhibited in table 4.4.10 and 4.4.11 respectively. Regarding the combined regression results for all individual one-year periods, the results yield conclusions similar to the raw returns. The correlation coefficients are positive at 0.250 and 0239 for traditional and conditional alpha measure respectively, showing evidences of significant persistence exist in rankings of risk-adjusted returns. The individual one-year periods have significant evidences of risk-adjusted return measured by traditional Jensen measure ranking persistence except 2001-2002 while conditional Jensen measure rankings show two one-year periods 2001-2002 and 2002-2003 having insignificant positive correlation coefficient. The mean correlation coefficient is computed to be 0.329 with a standard deviation of 0.159 for traditional Jensen measure; the mean is found to be 0.248 with a standard deviation of

0.183 for conditional Jensen measure. The magnitude of the mean is lower than that in the raw return ranking persistence analysis. However, the coefficient is still positive which shows persistence in Jensen alpha rankings.

The Spearman rank correlation coefficient is also computed to evaluate the evidences of persistence in risk-adjusted performance measured by Fama-French three-factor measure. Similar to the proceeding analyses, the result summarized in table 4.4.12 also indicates that the Fama-French three-factor alpha rankings have positive but weaker persistence; panel B of the table points out that the correlation coefficient is also positive but the correlation coefficient is not significant at even 10% significance level. Panel A of the table also indicates the Fama-French three-factor alpha measure is persistent significantly in the annual interval 2002-2003 at 5% significance level, which is consistent with the parametric regression analysis summarized in table 4.4.8.

4.5 Further analysis of performance persistence

4.5.1 Relation between fund volatility and performance persistence

Previous studies found that higher volatile funds have lower probability to survive and higher volatile surviving funds tend to have better performance (Brown *et. al.* (1992)). The finding reveals that the high-volatile funds may dominate the category "winner-winner" and few high-volatile funds are in the category "winner-loser" as the funds in this category may not survive. This bias is named as selection bias. Higher volatile funds are expected to have higher selection bias.

Although there are no funds in the current trustees ceased their operations during the sample period 2001-2004, it is interesting to investigate the relation between the fund volatility and performance persistence. The sample funds are separated into two batches, high- and low-volatile funds using the median variance over the entire period 2001-2004 as the critical value to split the funds. The funds that have variances equal or larger than the median variance are classified as high-volatile, and low-volatile funds are then defined as the funds with variances lower than the median. Analogous contingency tables are constructed for two different subsets of funds.

The two-way contingency tables of raw returns of funds separated as high-volatile and low-volatile funds over successive annual periods are presented in panel A of table 4.5.1. The combined result of all successive annual periods is then summarized in panel B of table 4.5.1, which shows the numbers and percentages in each batch. The combined results of all successive annual periods show that the high-volatile funds have higher percentage of funds in the category "winner-winner" (82.35%) than the other three categories (17.65% in WL, 43.18% in LW, and 56.82% in LL respectively), and the evidence of repeat winner-winner phenomenon in the sub-sample of high-volatile funds is stronger than that in the low-volatile funds (64.29%). These results indicate the hypothesis stated by Brown *et. al.* (1992) that the high volatile funds should have better performance in order to survive is not rejected in the case of Hong Kong MPF. Goetzmann and Ibbotson (1994) also found that high-volatile funds have stronger persistence in their performance and cited that this phenomenon indicates survivorship may be a possible source of bias in the performance study. However, the difference between the respective percentages in the "winner-winner" category for high-volatile and low-volatile funds is not quite significant, which implies the selection bias does not mitigate the performance persistence study.

4.5.2 Quarterly, semi-yearly and monthly performance persistence

Goetzmann and Ibbotson (1994) claim the previous studies on persistence in mutual fund returns which focused upon long-term performance have one problem of lack of statistical power because of cross-sectional dependence of mutual fund returns, what they cite as a "styles" problem. Goetzmann and Ibbotson found that most of the authors do not aware of the cross-sectional dependence of returns such that they believe if the returns are adjusted for risk, the cross-sectional dependence may be eliminated. To maximize the number of independent time periods, the evidences of persistence in quarterly and semi-yearly performance are also studied. The quarterly and the semi-annually risk-adjusted returns are found by running the Jensen single-factor model (equation 3.2.1) on the monthly returns of equity funds and those of benchmark indices in each quarter and semi-year respectively. The combined regression results of the parametric approaches to test the evidences of persistence in quarterly and semi-yearly performance, measured by raw and risk-adjusted returns, are presented in tables 4.5.2 and 4.5.3 respectively. No evidences of significant performance persistence are found except the semi-annually raw returns and monthly raw returns. The persistence coefficients indicate controversial results if different measures of performance is used. For the quarterly time span, the persistence coefficient indicates an insignificant risk-adjusted return persistence; while the persistence coefficient on the other hand indicates an insignificant reversal if the performance is measured by raw returns. The semi-annually performance have similar pattern. The persistence coefficient reveals an insignificant reversal in risk-adjusted returns but a significant persistence in raw returns. However, the persistence coefficient shows that evidence of significant persistence exists in monthly raw returns. The risk-adjusted returns of the funds may not be found in the monthly horizon as the minimum time horizon of the data is monthly. The major reason for controversial results is that the prediction of each semi-annually and quarterly result is much noisier than the prediction of longer-term results such as one-year and two-year time spans.

4.5.3 Performance persistence of different groups of equity funds

The evidences of performance persistence in different fund groups are also studied. The funds are separated into seven portfolios: (1) HKEQ, portfolio of Hong Kong Equity funds; (2) USEQ, portfolio of U.S. Equity funds; (3) ASEQ, portfolio of Asia Excluding Japan Equity funds, (4) JPEQ, portfolio of Japan Equity funds; (5) PBEQ, portfolio of Pacific-Basin Excluding Japan Equity funds; (6) EUEQ, portfolio of European Equity funds; and (7) GBEQ, portfolio of Global Equity funds. The performance of the funds is measured on monthly basis. The average monthly returns of the equity funds in the same group is used as a proxy of monthly performance of that fund group. These seven fund groups are then separated into two batches: winners – which have average returns equal or above the median return of all seven fund groups in that month; and losers – which have average return below the median. The procedure is repeated every month. Similar to the contingency table set up in the previous section, all equity funds together in the same fund group is defined as winner-winner (*WW*) if it is in the category *W* for consecutive months; loser-loser (*LL*) if in the category *L* for consecutive months; winner-loser (*WL*) if a fund group shifts from winner to loser, and loser-winner (*LW*) vice versa.

The result of the investigation of evidences of performance persistence in different fund groups is summarized in table 4.5.5, using average monthly returns of all equity funds classified in the same fund group and the number in the cells of the two-way table is the number of repeat-winning, repeat-losing, winning-losing, and losing-winning monthly periods. Five out of seven fund groups have percentages of repeat-winning months equal to or more than 50%. The fund groups that exhibit performance reversals with percentages of repeat-winning months less than 50% are the groups that have relatively lower average raw returns, USEQ and EUEQ. It suggests that the equity funds in these two portfolios always shift from winner category in the initial month to the loser category in the subsequent month and implies that their occasional good performance may not persist which results in relatively poorer average performance. Among the five fund groups that exhibit repeat-winning ("hot-hand") phenomenon, two equity fund portfolios JPEQ and PBEQ exhibit significant repeating-winning phenomenon, at either 5% or 10% significance level. It is interesting that the equity funds in these two portfolios perform better relative to the other groups. The average raw returns of the funds in these two groups are relatively higher than the other figures.

Only one fund group USEQ exhibits the "cold-hand", in other words, repeat-losing phenomenon. Interestingly, this fund group is the fund group which performs the worst among all different fund groups. It implies that the equity funds classified as USEQ not only perform badly but also persist their bad performance in consecutive months. Two fund groups, HKEQ and JPEQ, show significant reversal in repeat-losing months as the percentages of the repeat-losing months are significantly less than 50%. It implies the equity funds in these two fund groups always shift from the loser category in the initial month to the winner category in the subsequent month, and it also suggests that their bad performance seem not to persist in the sample period 2001-2004.

4.5.4 Performance persistence of constituent funds provided by same investment manager

The performance persistence of the constituent funds provided by each investment manager is also studied. Conducting performance analysis for each investment manager consists of three major reasons. The first reason is that the funds under the same investment manager (i.e. same fund house) may be under the same evaluation and supervision of the same management. The investment teams of different funds under the same investment manager may share the same research, marketing, and administrative support. There is a high possibility that the constituent funds provided by the same investment manager employ similar investment strategies although they have different investment objectives. The study of performance persistence of the equity funds within the same investment manager may prove the hypothesis suggested by Brown and Goetzmann (1995) that short-term performance persistence may be caused by the correlation across the managers. This may contribute to the current literature on the association across the managers that are due to same strategy and supervision.

The second reason is due to the MPF system; the participants may only change the trustee or investment managers and have to choose the funds provided by the selected investment manager. They may not choose the funds provided by different investment managers at the same time. Due to this limitation in the system, the participants have more interest in whether the past performance records of investment managers are useful when selecting the investment managers.

The last reason is that the current individual MPF scheme participants have no right to select the trustees and investment managers, and such right is actually transferred to employers. The employers have more interest on the performance and performance persistence of the funds managed by the same investment manager rather than performance of individual funds.

Following the nonparametric approach used in section 4.4.1, two-way contingency tables are constructed to examine the evidences of performance persistence of the funds provided by the same MPF investment manager. The performance of the funds provided by the same investment managers are measured on monthly basis. The average monthly returns of all equity funds offered by the same investment managers are used as a proxy of monthly performance of each investment manager. The investment managers are then separated into two groups: winners – which have average returns equal or above the median return of all investment managers for that month; and losers – which have average returns below the median. The procedure is repeated every month. Similar to the nonparametric approach by contingency table in the previous section, an investment manager is defined as winner-winner (*WW*) if it is in the category *W* for consecutive months; loser-loser (*LL*) if a investment manager is in the category *L* for consecutive months; winner-loser (*WL*) if a investment manager shifts from *W* to *L* and a investment manager shifts from L to W is then defined as loser-winner (LW). An MPF investment manager is considered as having significant evidence of performance persistence if the probability of repeating previous month's above median returns (repeat winning) is significantly more than 50%, which is diagnosed by the test statistic given in equation (4.2.1).

Table 4.5.6 summarizes the two-way contingency table using average monthly returns of all equity funds of each investment manager and the number in the cells of the two-way table is the number of repeat-winning, repeat-losing, winning-losing, and losing-winning monthly periods. The two-way table is supplemented with repeat-winning and repeat-losing z-statistics to investigate the significance of the persistence.

Contrary to the findings summarized in table 4.4.1 that indicates there is evidence of performance persistence in raw returns over successive 1-year intervals, the results in table 4.5.6 indicate most of the investment managers do not have percentages of repeat-winning months significantly more than 50%, 14 out of 21 investment managers which offer equity funds show the percentages of repeating winning months less than 50%. Among the seven investment managers which exhibit a percentage of repeating winning months larger than 50%, three show percentages significantly larger than 50% at either 10% or 1% significant level. They are First State Investments (HK) Ltd (trustee: CMG Asia Trustee Company Limited), Kingsway Fund Management Limited (trustee: HSBC Institutional Trust Services (Asia) Limited) and Nexus Trust Services (HK) Limited (trustee: Dexia Trust Services HK Limited appointed by Standard Chartered MPF). It implies that the equity funds offered by these three investment managers tend to repeat winning monthly periods. More investment managers exhibit percentages of repeat-winning months less than 50%, in other words, reversal. Among them, five investment managers BOCI-Prudential Asset Management Limited (trustee: BOCI-Prudential Trustee Limited), HSBC Provident Fund (HK) Limited (trustee: HSBC Provident Fund Trustee (HK) Limited), Hang Seng MPF Services (trustee: HSBC Provident Fund Trustee (HK) Limited), Fidelity Investments Management (Hong Kong) Limited (trustee: HSBC Institutional Trust Services (Asia) Limited), and Manulife Provident Funds Trust Company Limited exhibit significant reversal at either at 10% or 1% level of significance. It suggests that the equity funds offered by these investment managers tend to have more losing months after winning months.

Regarding the percentage of repeating losing months, only one investment manager show significant persistence with percentage of repeat-losing months significantly larger than 50% – Manulife Provident Funds Trust Company Limited. Among the 21 investment managers which offer equity funds, only seven of them show percentages of repeat-losing months equal to or larger than 50%. It suggests that the cold-hand phenomenon hypothesis is not supported. On the other hand, more investment managers which are losers in the initial month are more likely to be followed by being winners in the subsequent months. Five of them exhibit repeat losing percentage significantly less than 50% at 1% to 10% significance level.

Table 4.5.7 provides the comparison of conditional and unconditional probabilities of repeat-winning and repeat-losing monthly periods respectively. The investment managers are listed according to their rank orders of repeat-winning percentages and repeat-losing percentages in the table. Columns 3 (and 6) present the repeat-winning (losing) percentages which use the number of initial winning(losing) monthly periods as the base. Columns 4 (and 7) show the overall *W-W*(*L-L*) percentages which on the other hand use the total number of monthly periods as the base. Columns 5 (and 8) exhibit the rank orders based on their overall *W-W*(*L-L*) percentages ranked from the largest percentage. The comparison results of columns 3 and 4 indicate a clear incidence that the investment managers with higher percentages of repeat-winning monthly periods also have relatively higher percentages of overall W-W percentages. It indicates the investment managers which are always winners in successive monthly periods have lower possibilities of being losers in the period 2001-2004 and implies that the hot-hand investment managers (with percentages of repeat winning monthly periods more than 50%) are more likely to have relatively superior performance than the cold-hand investment managers. Column 8 confirms that the hot-hand investment managers have relatively less overall *L-L* percentages and lower overall *L-L* percentage ranks. It implies that the superior investment managers not only performs well but also are less likely to persist inferior performance.

4.6 Conclusions

The primary focus of this chapter is upon the issue of performance persistence of MPF equity funds. This study provides the first comprehensive study on the performance persistence of MPF equity funds. Several statistical tests (repeat winners test, cross-product-ratio test, chi-square test) that supplement the two-way contingency table have been employed and compared to evaluate the performance persistence and the result indicates that the past performance of a fund has long been used as an indication of future performance. Overall, there is strong evidence of persistence with a significant chi-square statistic of 25.6061, a significant z-statistic of 4.9 for cross-product-ratio test, significant z-statistic of 3.9001 and 3.2549 for repeat winners and repeat losers respectively. Previous studies outside Hong Kong found little evidences of performance persistence; while evidences of annual raw return persistence were proved by both nonparametric contingency tables and parametric regression analysis in this study. Annual horizon seems to be appropriate as the data may be affected by noise if the time horizon is too short. On the other hand, choosing so long of a period may allow the skill level of the fund manager to change.

The hypothesis that the performance persistence evidences are not affected by the risk adjustment was also tested in this study. The persistence evidences of risk-adjusted returns measured by traditional Jensen alpha measures, conditional Jensen alpha measures and Fama-French three-factor alpha measures were investigated. The phenomenon that the past risk-adjusted returns are useful in predicting risk-adjusted returns was found although the evidence of persistence becomes weaker after adjusting for risks.

Not only the past annual raw returns and risk-adjusted returns are useful in predicting the future raw and risk-adjusted returns; but also the annual relative return rankings of the MPF funds are useful in predicting future return rankings shown by positive and significant Spearman Rank Correlation Coefficient. Having identified performance persistence at the annual horizon may give the MPF scheme participants an implication that the MPF mandate may be set up on an annual basis although this might ignore the fund shifting cost at such regular intervals.

The data were then controlled for volatility by splitting the funds into high-volatile and low-volatile funds and the results continue to exhibit repeat-winner and repeat-loser patterns. The repeat-winner pattern is more significant in the group consisting of samples of high-volatile funds, which implies the high-volatile funds put more effort to repeat their good performance in order to survive.

One approach to eliminate the “style” factors or unidentified common variations rather than the market is to increase the number of independent time period observations by using the semi-annually, quarterly, and monthly returns. The semi-annually and monthly raw returns are also consistent with the hypothesis of existence of return persistence hypothesis; on the other hand, the quarterly raw returns and semi-annually risk-adjusted returns exhibit reversals. Controversial evidences of performance persistence, which were found in shorter-horizon performance, seem to be due to the noisier data than the annual returns.

The equity funds were also divided into seven clusters according to their fund groups. Nonparametric contingency tables were employed to detect the evidences of raw return persistence of the funds in the same group. The US equity funds and European equity funds exhibit that they have higher possibility shifting from winner category to the loser category; the Japanese equity funds and Pacific-Basin excluding Japan equity funds show that they are more possible staying in the winner category; while the Hong Kong equity funds and Japanese equity funds show that they do not persist their bad performance.

Finally, this chapter takes on a different perspective to explore the persistence pattern of Hong Kong MPF. Besides studying the performance persistence of individual equity funds and different fund groups, the performance persistence of investment managers, which are assigned by the MPF fund trustees and are offering equity funds, were also examined. Different from the studies on the performance persistence of individual funds or portfolios of funds classified by their investment regions, only 7 out of 21 investment managers are found to exhibit repeat winning patterns and among them only three investment managers have significant repeat-winning percentages on monthly basis. Thus, there does not appear to be a hot hand phenomenon in investment managers of MPF equity funds. The phenomenon of persistent inferior performance shown by repeat losing percentages is also not evident, as only one investment manager exhibit significant repeat-losing percentage. The comparison of conditional and unconditional probabilities of repeat-winning and repeat-losing monthly periods shows a strict association between the investment manager's performance persistence and its overall performance. The investment managers exhibit high repeat-winning percentages which are conditional on their prior performance tend to also have higher overall W-W percentages which are unconditional on their prior performance. These investment managers also tend to have lower overall L-L percentages and imply they are less likely to persist inferior performance.

In conclusion, this chapter may provide us a picture that the past performance of the MPF equity especially the performance in the previous year may be a good indication of the performance in the coming year. The MPF participants may use historical information to beat the pack and the past performance may also be a good indicator to find out good investment managers versus bad ones.

CHAPTER 5 MARKET TIMING OF MPF EQUITY FUNDS

5.1 Introduction

Timing refers to a fund manager's ability to time the market, that is, to increase a fund's exposure to the market index prior to market advances and to decrease exposure prior to market declines. If fund managers possess market timing ability, they may successfully forecast the suitable time to be in the relatively-higher-risk equity market and out of the relatively-lower-risk fixed-income market, or vice versa. Identifying funds that are successfully timing the market is not only an interesting academic question but also of great practical importance. For the former, the evidence of timing ability violates the EMH. For the latter, such evaluations may provide a guide for the allocation of investment funds. A large portion of Hong Kong employees have to contribute a part of their salary to MPF, the investing public's interest in identifying successful fund managers is understandable. Especially in light of mounting evidence that the returns of most actively managed funds are lower than index fund returns in the first two operating years. Most of the MPF fund managers advocate themselves as having either superior stock selection (micro-forecasting) skill or market timing (macro-forecasting) skill, therefore it is necessary to investigate these two different skills that are perceived to be existence and to distinguish between them.

The principal issue to be examined in this chapter is how effective are the MPF at market timing. Treynor and Mazuy (1966) show that if the fund managers continuously try to time the market, the relationship between fund portfolio returns and market returns, i.e. the characteristic line, will no longer be straight. The previous studies on market timing attempted to accommodate the nonlinearity and changes in the systematic risk by using some forms of nonlinear model, especially quadratic regression models. This study extends the market timing literature by examining data from MPF. The methodologies followed involve running quadratic excess returns model, namely Treynor and Mazuy (1966) (T-M) model, and dual-beta excess returns model, namely Henriksson and Merton (1981) (H-M) model. Following Ferson and Schadt (1996), both T-M and H-M models are also conditioned on public information to derive conditional T-M and H-M models. The conditional versions of T-M and H-M models are also employed to evaluate the market timing ability. In addition, some specification tests suggested by Jagannathan and Korajczyk (1986) are also applied to diagnose if some higher-order models are appropriate.

The remaining parts of this chapter are structured as follows. Section 5.2 summarizes the research methodology employed to determine the market timing of the MPF equity fund managers. Section 5.3 describes the data used. Section 5.4 presents the empirical results of identification of market timing of equity funds. Section 5.5 presents modified models that may identify the market timing of balanced funds. Section 5.6 is a summary of this chapter.

5.2 Research methodology: Identification of market timing of equity funds

Ideally, to test the market-timing ability of fund managers, the data on the actual asset shares are required to see if the manager increases his exposure to the market just before a rise in the market or decreases his exposure vice versa. Without such data of asset share portfolios of the funds, Treynor and Mazuy (T-M) regression or Merton and Henriksson (H-M) regression are two commonly used models to investigate the fund managers' market timing ability.

5.2.1 Jensen alpha measure

The starting point for this study is Jensen's alpha obtained by the CAPM model which assumes that funds have no market timing ability. This is the most commonly employed measure to evaluate the performance of mutual (or pension) funds. Suppose $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio; the Jensen measure refers to the intercept α in the regression model of return of the fund, *i,* in excess of the 1-month risk-free rate on the excess return on the market portfolio. The Jensen alpha model has been shown in equation (3.2.1) in chapter 3.

If the CAPM is a correct model of equilibrium returns, the portfolio of a fund should lie on the security market line and the value of Jensen alpha, α_i in equation (3.2.1), should be zero. Therefore, a significant positive Jensen alpha indicates superior performance if a fund manager possesses stock selection ability to outperform the market but no timing ability.

5.2.2 Unconditional Treynor and Mazuy (T-M) model

The T-M model assumes that if fund managers forecast the market returns successfully, they would tilt larger proportions of the market portfolio in an up market and smaller proportions of the market portfolio in a down market. Treynor and Mazuy (1966) tested the existence of market timing ability by the presence of curvature of the characteristic line, which is a plot of the rate of return of a fund against the rate of return of a market. When the fund manager increases the portfolio's exposure to market index during an up market and vice versa, the portfolio will be more volatile and make the characteristic line for the respective fund no longer straight (linear). This shift will produce a convex characteristic line. Equation (5.2.1) describes the unconditional T-M regression model:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + \gamma \cdot \left(R_{m,t} - R_{f,t}\right)^2 + e_t \tag{5.2.1}$$

where $R_{i,t}$ is the periodic rate of return on the fund *i* in period *t*, $R_{m,t}$ is the periodic rate of return on the market index in period *t*, $R_{f,t}$ is the risk-free rate at the start of period *t*. A positive value of γ represents superior market-timing skill because it implies that portfolio returns respond more positively to upswings than to downturns in the market. $\gamma = 0$ It implies no market-timing, while a negative γ indicates inferior market-timing.

Treynor and Mazuy (1966) have not derived the above relationship theoretically. Admati, Bhattacharya, Pfleiderer, and Ross (1986) show that the relationship in equation (5.2.1) is appropriate under specific assumptions. Admati *et. al.* (1986) show that if the fund manager increases the sensitivity to stocks when the market return is increasing, the coefficient γ will be positive. This can be done by isolating the time-varying market model beta from the T-M model:

$$\beta_{i,t} = \beta_i + \gamma_i \cdot \left(R_{m,t} - R_{f,t}\right)$$

When the timing coefficient is positive, the relation between the time-varying beta and the excess return on the market benchmark will be positive. Hence, higher exposure on market when the market return is higher may make the timing coefficient γ positive. However, the T-M model does not measure the fund managers' timing ability across various classes of investment vehicles.

5.2.3 Unconditional Henriksson and Merton (H-M) model

Henriksson and Merton (1981) developed the "dual-beta" model for evaluating market timing ability. Their model takes into account the asymmetric forecasting skills of fund managers, i.e., different in up versus down markets. The model is constructed by fitting two linear regressions to the data, one for up markets when the fund outperforms the risk-free return rate and one for down markets in case of underperformance. Equation (5.2.2) describes the unconditional H-M model:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot \left(R_{m,t} - R_{f,t}\right) + \gamma \cdot \left[D \cdot \left(R_{m,t} - R_{f,t}\right)\right] + e_t \qquad (5.2.2)$$

where D is a dummy variable given a value of -1 for periods in which $R_{m,t} - R_{f,t}$ is negative (i.e. down market) or a value of zero otherwise. The assumption behind the H-M model is that the fund manager may forecast correctly where market returns exceed the risk-free rate. The intercept α in equation (5.2.2) is the risk-adjusted return which measures the stock-selection ability. The coefficient β is the systematic risk of the fund which represents the beta of the portfolio in up markets, while the coefficient γ measures the market-timing skill.

5.2.4 Jagannathan and Korajczyk (J-K) specification tests

Jagannathan and Korajczyk (1986) argue when the fund managers invest in options or levered securities, evidences of existence of spurious market timing ability in them may be found. Hence, they suggest specification tests to help distinguishing between spurious and true timing ability. They augmented the market-timing models by additional higher-order variable(s). The additional variables should not be significant if the current market-timing models such as T-M and H-M models are appropriate. Jagannathan and Korajczyk suggested two specification tests; the first one is T-M model augment by a cubic term and takes the following form (augmented T-M model):

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot (R_{m,t} - R_{f,t})^2 + \delta \cdot (R_{m,t} - R_{f,t})^3 + e_t \qquad (5.2.3)$$

where δ is the additional higher-order coefficient, which is not significant if the currently used T-M model is appropriate.

The other is H-M model augmented by a quadratic term suggested by Jagannathan and Korajczyk and takes the following form:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot [D \cdot (R_{m,t} - R_{f,t})] + \delta \cdot (R_{m,t} - R_{f,t})^2 + e_t \quad (5.2.4)$$

where δ is the additional higher-order coefficient, which is not significant if the currently used H-M model is appropriate.

5.2.5 Conditional T-M and H-M models

The unconditional models have one weakness in that superior performance may be incorrectly attributed to manager skill rather than abnormal performance due to the use of public information. Ferson and Schadt (1996) have recognized it is important to incorporate changing economic conditions in evaluating mutual fund performance. Ferson and Schadt (1996) show that a fund manager might be successful in using public information to enhance returns which the traditional unconditional models may incorrectly attribute to superior performance. They indicated that a good performance that can be achieved by replicating readily available public information should not be considered as having superior performance. They argued that the possibility that a manager gets credit for a strategy that just uses public information only should be eliminated. Hence, they advocate conditional performance evaluation in which public information variables are used to improve performance measurement. Shanken (1990) specifies the beta in the conditional model by Taylor series to derive a linear function of public information vector Z_t that captures changing economic conditions as follows:

$$\beta_i(Z_t) = b_{1,i} + b_{2,i} z_t \qquad (5.2.5)$$

where $Z_t =$ information set available to fund manager at time t

$z_t = Z_t - E(Z_t) =$ deviations of each member of Z_t from its conditional mean

By multiplying the excess market return $R_{m,t} - R_{f,t}$ in unconditional T-M model (5.2.1) to $\beta_i(Z_t)$ specified in equation (5.2.5), conditional T-M model (5.2.6) will be derived as follows:

$$R_{i,t} - R_{f,t} = \alpha + b_{1,i}\left(R_{m,t} - R_{f,t}\right) + b_{2,i}\left[z_t\left(R_{m,t} - R_{f,t}\right)\right] + \gamma\left(R_{m,t} - R_{f,t}\right)^2 + e_t \qquad (5.2.6)$$

The coefficient $b_{2,i}$ captures the fund managers' response to the public information. The coefficient γ measures the market timing with respect to information that is publicly available. If the fund manager's success in market timing is due to the publicly available information, it will be expected the conditional model to provide no evidence of being successful market timer.

To extend the unconditional H-M model to account for public information, Ferson and Schadt (1996) developed the following approach; they assumed that the fund manager attempts to forecast $\left(R_{m,t} - R_{f,t}\right) - E\left[\left(R_{m,t} - R_{f,t}\right)\middle| Z_t\right]$, which is the deviation of excess market return from the expected excess market return, conditional on the public information. If such forecast is positive, the fund manager should choose a portfolio conditional beta that captures changing economic conditions given as follows:

$$\beta_u(Z_t) = b_{u,i} + b'_u z_t \qquad (5.2.7)$$

If the manager forecast that the deviation may be negative, he should choose

$$\beta_d(Z_t) = b_{d,i} + b'_d z_t \qquad (5.2.8)$$

Using these two models for portfolio betas, the conditional version of H-M model may be derived as follows:

$$\begin{aligned} R_{i,t} - R_{f,t} &= b_d\left(R_{m,t} - R_{f,t}\right) + b'_d\left[z_t\left(R_{m,t} - R_{f,t}\right)\right] + \gamma^*\left(R_{m,t} - R_{f,t}\right)^* + \\ &\delta\left[z_t\left(R_{m,t} - R_{f,t}\right)\right] + \left\{\left(R_{m,t} - R_{f,t}\right) - E\left[\left(R_{m,t} - R_{f,t}\right)\middle| Z_t\right]\right\} \end{aligned} \qquad (5.2.9)$$

where $\left(R_{m,t} - R_{f,t}\right)^* = \left(R_{m,t} - R_{f,t}\right) I\left\{\left(R_{m,t} - R_{f,t}\right) - E\left[\left(R_{m,t} - R_{f,t}\right)\middle| Z_t\right] > 0\right\}$, $\gamma^* = b_{u,i} - b_{d,i}$, $\delta = b'_u - b'_d$, and $I\{\bullet\}$ is indicator function.

Zero γ^* and δ support the null hypothesis of no market timing ability. The alternative hypothesis of having positive market timing ability may be tested by $\gamma^* + \delta \cdot z_t > 0$, which implies that the conditional beta is higher when the market is above its conditional mean, than when it is below the conditional mean given public information.

The alternative to construct the conditional version of H-M model is to combine the unconditional version of H-M model with the following Taylor series derived by Shanken (1990):

$$\beta_i(Z_t) = b_{1,i} + b_{2,i} z_t;$$
$$\gamma_i(Z_t) = g_{1,i} + g_{2,i} z_t \qquad (5.2.10)$$

where Z_t = information set available to fund manager at time *t*

By multiplying the excess market return $R_{m,t} - R_{f,t}$ in unconditional H-M model (5.2.2) to $\beta_i(Z_t)$ and $\gamma(Z_t)$ that is specified in equation (5.2.10), the conditional H-M model (5.2.11) may also be derived as follows:

$$\begin{aligned} R_{i,t} - R_{f,t} &= \alpha + b_{1,i}(R_{m,t} - R_{f,t}) + b_{2,i}\lfloor z_t(R_{m,t} - R_{f,t})\rfloor + g_{1,i}\lfloor D \cdot (R_{m,t} - R_{f,t})\rfloor \\ &+ g_{2,i}\{z_t \lfloor D(R_{m,t} - R_{f,t})\rfloor\} + e_t \end{aligned} \qquad (5.2.11)$$

The coefficient $b_{1,i}$ is the unconditional beta, $b_{2,i}$ captures the fund managers' response to the public information. The coefficient $g_{1,i}$ measures the timing ability on the market and $g_{2,i}$ captures the timing ability on the various public information variables.

The conditional Jensen model uses public information variables that are the same as those used to derive the conditional Jensen measure. These variables are (1) the lagged level of 1-month MPFA prescribed saving rate (SAV_{t-1}); (2) the dummy variable for the month of January (JAN_t); (3) the lagged dividend yield in the Hang Seng Index (DIV_{t-1}); (4) the lagged term spread which is the difference between the maturity 10-year HKMA Exchange Fund Note and the 91-day HKMA Exchange Fund Bill, both are annualized monthly averages $(TERM_{t-1})$; and (5) the lagged default spread which is the difference between the Moody's BAA-rated corporate bond yield and the AAA-rated corporate bond yield, using the monthly average yields for the previous month (DEF_{t-1}).

Thus the public information vector Z_t consists of the five economic variables mentioned above and the product $b'_{2,i} \cdot Z_t$ will be a linear combination of these five variables as follows:

$$
\begin{aligned}
& b'_{2j} \cdot Z_t = b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + \\
& b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}
\end{aligned}
\tag{5.2.12}
$$

where $b_{SAV,t}$, $b_{JAN,t}$, $b_{DIV,t}$, $b_{TERM,t}$, and $b_{DEF,t}$ measure the extent to which the conditional beta diverges when market indicators are taken into account.

The conditional T-M model specified in equation (5.2.6) may be modified by combining equation (5.2.12) to derive the following conditional T-M model (5.2.13) that incorporate the five economic variables and will be used to test the fund managers' market timing ability:

$$
\begin{aligned}
& R_{i,t} - R_{f,t} = \alpha + \\
& \left(b_{1,i} + b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}\right) \times \\
& \left(R_{m,t} - R_{f,t}\right) + \gamma\left(R_{m,t} - R_{f,t}\right)^2 + e_t
\end{aligned}
\tag{5.2.13}
$$

where α is the conditional performance measure of selectivity, $b_{1,i}$ stands for the unconditional beta, $b_{SAV,t}, b_{JAN,t}, b_{DIV,t}, b_{TERM,t}$, and $b_{DER,t}$ measure the extent to which the conditional beta diverges when market indicators (MPFA prescribed saving rate, January dummy variable, dividend yield in the Hang Seng Index, term spread, and default spread, all lagged one period) are taken into account. The coefficient γ captures the market-timing ability if public information is taken into account.

Using the same five economic variables, the conditional H-M model specified in equation (5.2.11) may be modified by combining equation (5.2.12) to derive the following conditional H-M model (5.2.14) that will be used in the empirical study in this section:

$$
\begin{aligned}
&R_{i,t} - R_{f,t} = \alpha + \\
&\left(b_{1,i} + b_{SAV,t} \cdot SAV_{t-1} + b_{JAN,t} \cdot JAN_{t-1} + b_{DIV,t} \cdot DIV_{t-1} + b_{TERM,t} \cdot TERM_{t-1} + b_{DEF,t} \cdot DEF_{t-1}\right) \times \\
&\left(R_{m,t} - R_{f,t}\right) + \\
&\left(\gamma + g_{SAV,t} \cdot SAV_{t-1} + g_{JAN,t} \cdot JAN_{t-1} + g_{DIV,t} \cdot DIV_{t-1} + g_{TERM,t} \cdot TERM_{t-1} + g_{DEF,t} \cdot DEF_{t-1}\right) \times \\
&\delta_t \left(R_{m,t} - R_{f,t}\right) + e_t
\end{aligned}
\tag{5.2.14}
$$

with $\delta_t = \{1 \text{ if } R_{m,t} > E(R_{m,t}), 0 \text{ otherwise}\}$, (5.2.14A)

$$
\begin{aligned}
E(R_{m,t}) = \lambda_{1,t} + \lambda_{SAV,t} \cdot SAV_{t-1} + \lambda_{JAN,t} \cdot JAN_{t-1} + \lambda_{DIV,t} \cdot DIV_{t-1} + \\
\lambda_{TERM,t} \cdot TERM_{t-1} + \lambda_{DEF,t} \cdot DEF_{t-1}
\end{aligned}
\tag{5.2.14B}
$$

where α is the conditional performance measure of selectivity, $b_{1,i}$ stands for the unconditional beta, $b_{SAV,t}, b_{JAN,t}, b_{DIV,t}, b_{TERM,t}$, and $b_{DER,t}$ measure the extent to which the conditional beta diverges when market indicators (MPFA prescribed saving rate, January dummy variable, dividend yield in the Hang Seng Index, term spread, and default spread, all lagged one period) are taken into account. The variable δ_t is a dummy variable corresponding to up and down markets. The conditional mean $E(R_{m,t})$ is estimated by performing a linear regression of the excess return of the various benchmarks on the five public information variables. The coefficient γ captures the market-timing ability if public information is taken into account.

5.3 Data

All the analyses of this chapter use the same dataset as in chapter 3. The details of the description of the dataset which contains monthly prices (NAV) of all equity funds included in the MPF scheme, and the procedures to compute monthly returns and to form respective equally-weighted portfolios for different fund groups are presented in section 3.3.

The methodologies described in section 5.2 involve two proxy variables: the risk-free rate $(R_{f,t})$ and a market index $(R_{m,t})$. The MPFA prescribed savings rate quoted by the Mandatory Provident Fund Scheme Authority was used as a proxy for the risk-free rate $(R_{f,t})$. The source of the quotes and the conversion procedure to monthly rates from annual rate has been described in section 3.3 of chapter 3.

The logarithmic return on the respective benchmark index for different groups of funds is used as a market index proxy $\left(R_{m,t}\right)$. The respective benchmark indexes for different groups of funds are summarized in table 1.2.9. The source of these benchmark indices for respective portfolio of equity funds is described in section 3.3 of chapter 3.

The conditional version of T-M and H-M models described in section 5.3.5, including five additional variables that are used to proxy public information. The source of the data for three additional variables DIV_{t-1}, $TERM_{t-1}$, and DEF_{t-1} is described in section 3.3 of chapter 3.

5.4 Empirical results: Identification of market timing of equity funds

(1) Unconditional timing measures

The results for the unconditional Treynor and Mazuy (T-M) model (equation 5.2.1) for respective portfolio of MPF funds are summarized in table 5.4.1(a). Compare with table 3.4.1, which exhibits the results for the traditional Jensen measure to evaluate the performance of respective portfolios of MPF funds, the unconditional T-M model also shows that the portfolio PBEQ possesses an unfavorable (negative) but statistically insignificant alpha. When investigating the average market timing performance by running T-M model on all-fund portfolio, the T-M model shows the existence of evidence that all sample fund managers on the average possess positive market timing ability ($\gamma = 0.084$ with t-statistic = 1.179). When the T-M model is run on the individual fund portfolios, we may find that four out of seven equity fund portfolios exhibit favorable market timing ability. These four portfolios are JPEQ, PBEQ, EUEQ, and GBEQ. Except the timing coefficients for JPEQ and GBEQ, all are statistically insignificant at 10% level. If comparing the traditional Jensen alphas summarized in table 3.4.1 with the alphas found by the unconditional T-M model for these four portfolios, the traditional Jensen alphas of these four portfolios are found to be higher than the alphas in this table, the existence of superior timing ability in the fund managers of the funds in these portfolios may be the main reason. On the other hand, the traditional Jensen alphas of the three portfolios that exhibit inferior market timing ability

(HKEQ, USEQ, and ASEQ) are lower than the alphas found by unconditional T-M model. These findings prove that the unconditional T-M model may capture the existence of market timing ability in the MPF fund managers. Conclusively, the results tell us that the Japanese equity funds, European equity funds, and global equity funds in the MPF scheme may outperform the benchmark and possess superior market timing ability.

Table 5.4.5 shows the distribution of timing coefficients of individual funds by running a separate market timing model for each fund. A larger proportion of positive timing performance than that documented in literature is found in the samples. The second column of table 5.4.5 presents the distribution of T-M timing coefficients of individual funds. Of the 64 individual equity funds (two don't have sufficient monthly returns to generate the T-M model), 32 (50% of effective samples) funds exhibit positive timing coefficients when T-M model is used to evaluate the market timing ability. Table 5.4.6 summarizes the number of funds with positive and negative timing coefficients classified by fund groups, and the first column presents the number of timing coefficients run by the unconditional T-M model. Among the 32 funds with positive timing coefficient, only seven of them are significant at level of 10% or less (shown in table 5.4.1(b)); all of them are in either EUEQ or GBEQ group. All these seven European equity funds and global equity funds exhibit negative but not significant stock selection coefficient, which is consistent with the findings documented in previous literature.

Table 5.4.2(a) summarizes the results obtained using unconditional Henriksson and Merton (H-M) model (equation 5.2.2). Consistent with Gregoriou (2004), the timing coefficient run by the H-M model on all fund portfolio exhibits the sign that is opposite to it when it is run by the T-M model. H-M model indicates that the MPF equity fund managers, on the average, possess negative market timing ability. This finding shows that the fund managers unsuccessfully time the market when the market declines, especially during the years 2001 and 2002. Similar to the findings in T-M model, the portfolios HKEQ, USEQ, and ASEQ exhibit negative market timing coefficients and only the portfolio of USEQ is statistically significant at 1% level. By comparing with table 3.4.1, the H-M model seems to be able to capture the market timing ability as the portfolios with negative market timing coefficients exhibit smaller traditional Jensen alphas than alphas run by the H-M model; on the other hand, those having positive market timing coefficients may produce a higher traditional Jensen alpha. For the USEQ portfolio, both T-M and H-M models prove that the US equity fund mangers on the average may not outperform the benchmark (negative Jensen alpha shown in table 3.4.1) is mainly due to the inability to time the market. The distribution of positive and negative timing coefficients found by H-M model is shown in the third column of table 5.4.5, which shows that the proportion of negative H-M timing coefficients is higher (54.7% of effective samples, or 35 equity funds) than that obtained when running T-M timing model. A comparison of timing coefficients of individual fund between T-M and H-M models indicate that all of these are identified as superior market timing performers by H-M model are also regarded as superior market timing performers by T-M model. Only three funds which are identified as inferior market timing performers by H-M model are identified as, on the other hand, having superior market timing ability by T-M model.

The number of funds with positive and negative timing coefficients from unconditional H-M model classified by fund group is summarized in the second column of table 5.4.6. Among the 29 funds that exhibit positive H-M timing coefficients, four of them are significant at 5% or 10% level, as shown in table 5.4.2(b). Two are in GBEQ group and the other are in EUEQ group. These four equity funds are also detected as having significant positive timing ability by T-M model; and these four equity funds with significant positive H-M timing coefficient are also found to be offset by poor stock selection performance.

Evidence of negative association between the stock selection ability (measured by alpha) and market timing performance (measured by gamma) is documented consistently in the literature. The evaluation result of the relation between the alpha measure and gamma measure of individual fund by correlation coefficient is summarized in table 5.4.7. The result shows that the correlation coefficient is negative regardless of which model is being used to evaluate the market timing performance (-0.463 for T-M and -0.704 for H-M), which is consistent with the studies previously documented.

(2) Conditional timing measures

The result of regression estimates for conditional version of T-M model (5.2.13) is summarized in table 5.4.3(a). The F-statistic for the significance of public information variables reveals that all additional variables may jointly explain the dynamics in returns of MPF funds even the square term of market returns is added, for all-fund portfolios or for portfolios of different fund group at 1% level. Under the conditional version, 64.5 % or 40 of the 62 estimates (four funds don't have sufficient amount of monthly returns to run the conditional T-M model) are found to be negative, which is exhibited in the fourth column of table 5.4.5. Compare with the unconditional version of T-M model, the proportion of funds exhibiting perverse timing ability is higher if the T-M model is conditional by public information variables. The decrease in the market timing coefficients agree with the assumption that the fund managers usually respond rationally to the public information and adjust accordingly, the conditional model will then control for this and worse market timing performance is expected. As the stock selection ability is found to be negatively associated with market timing performance, expecting market timing performance to be more negative when the T-M model is conditional on public information variables is proved. Panel B of table 5.4.3(a) reveals that all five predetermined public information variables are significant at either 1% or 5% level. When the conditional T-M model is run on respective equity fund portfolios, the number of significant public information variables is found to be less. Actually, the number of significant variables in the conditional T-M model run on individual equity fund portfolio is same to that in the conditional Jensen model run on individual equity fund portfolio (shown in table 3.4.2). The conditional T-M model suggests that market-timing effects become negative when conditional on public information but not significant.

The regression estimates of conditional H-M models for portfolio consisting of all funds and portfolios of different fund groups are summarized in table 5.4.4(a). Panel B of table 5.4.4 shows that the timing coefficient for all-fund portfolio changes from negative to positive as the H-M model is conditional on public information variables, this shows that the MPF fund managers, on average, have ability to improve the market timing performance by making use of public information during the market declines. The F-statistic of the regression estimate shows that the conditional version of H-M model is significant at 1% level. However, only seven among ten public information variables are significant at 1% level. Considering the conditional H-M model run on portfolios of different groups of funds, we may find that the timing coefficients of two portfolios JPEQ and PBEQ become negative as H-M model is conditioned on public information variables. That shows that the constituent funds within these two portfolios have preserve market timing performance when using public information during market declines. However, the funds within USEQ and ASEQ portfolios show opposite case; they present positive timing performance when public information variables are being considered.

Tables 5.4.3(b) and 5.4.4(b) show the number of funds with significant positive or negative market timing performance in different fund groups. Only one of the funds is detected to have significant preserve market timing performance simultaneously by conditional T-M and conditional H-M models at 5% level.

The fifth column of table 5.4.5 shows that 54.8% of 62 equity funds (four don't have sufficient monthly returns to run the conditional version of H-M model) or 34 equity funds have preserve market timing performance, while 40 equity funds exhibit having inferior market timing ability by conditional T-M model. Nine equity funds are found to have inferior market timing performance by conditional T-M model but are detected as having superior market timing ability by conditional version of H-M model, which implies that these funds are superior in using public information available to time the market when the market declines. These equity funds include four Hong Kong Equity funds and five Global Equity funds.

Three equity funds are, on the other hand, detected as having positive market timing ability by conditional T-M model but negative market timing performance by conditional H-M model. One is in the US Equity fund group and the other two are in Asian Equity fund group. These three funds are considered as not having ability to use public information to time the market when the market declines.

(3) Comparison of unconditional and conditional timing measures

To examine if the timing coefficient (γ) run by the unconditional T-M model is significantly different from that run by the conditional T-M model, parametric paired t-test and nonparametric Wilcoxon matched-pairs test are employed. The result of the test of evidences is summarized in table 5.4.8. The parametric *t*-test indicates that for the entire portfolio of equity funds, there is significant difference between the unconditional and conditional timing coefficients at 10% level. The non-parametric Wilcoxon *z*-test, may show the significant difference exists at 5% level. Within the different fund style portfolios, both tests consistently indicate the timing coefficients are significantly different for EUEQ portfolio. One controversial test result is found in PBEQ portfolio, the parametric *t*-test indicates there is significant difference between the unconditional and conditional timing coefficients at 1%; while the nonparametric Wilcoxon *z*-test gives a totally different result. The major reason is that all T-M timing coefficients of individual PBEQ funds change from positive to negative when T-M model is conditional on public information variables that make the Wilcoxon *z*-test may not indicate any significant difference.

(4) Specification test for unconditional timing models

The results of the specification tests of the T-M model and H-M model following the cubic augmented T-M model and quadratic augmented H-M model suggested by Jagannathan and Korajczyk (1986) are summarized in tables 5.4.9 and 5.4.10. Table 5.4.9(a) shows that for the T-M model augmented by cubic term, the cubic term is significant at 1% for the fund portfolios HKEQ and GBEQ; significant at 5% level for the portfolio ASEQ. Table 5.4.9(b) presents the number of individual funds with significant cubic term in the augmented T-M model that run separately; the table shows that there are 13 individual MPF funds out of 64 equity funds (two funds do not have sufficient monthly returns to run the augmented T-M model) or 20% of samples of equity funds reveal significant cubic term at 1%, 5% or 10% level. This suggests that the quadratic market timing model may be misspecified. Among these 13 significant cubic terms, majority of them (eight) are negative and only five of them are positive.

Considering the results of augmenting the unconditional H-M model, a quadratic term is added to augment the original H-M model and the results of the regression estimate are summarized in table 5.4.10. Table 5.4.10(a) reveals the case that is same to augmented T-M model; for augmented H-M model, which shows HKEQ and GBEQ portfolios have significant augmented variable at either 5% or 10% significance level. The augmented square term is no longer significant for ASEQ portfolio when the H-M model is augmented, but the augmented term of PBEQ portfolio becomes significant at 5% level in augmented H-M form. When the augmented H-M model is run separately on individual fund, 7 out of 64 funds with sufficient monthly returns to run the augmented H-M model have significant augmented square terms. This suggests a nontrivial degree of misspecification of the unconditional H-M model, which is consistent with the results in unconditional T-M model. Four of these, which are USEQ group constituent equity funds, are common to both sets of significant results reported in table 5.4.9(b) and 5.4.10(b).

5.5 Conclusions

The primary aim of this chapter is to find evidence of market timing ability in the MPF equity fund managers using unconditional (traditional) and conditional models. This study is the first comprehensive study to evaluate the market timing performance of the Hong Kong Mandatory Provident Funds (MPF) during the period 2001-2004. Regarding the market timing performance, the Treynor and Mazuy (T-M) and Henriksson and Merton (H-M) models provide contradictory conclusions on the market timing performance for the portfolio including all funds. T-M model indicates the MPF equity funds on the average possess positive but not significant market timing performance; while H-M model on the other hand indicates negative and insignificant market timing performance. That implies the fund managers may not time the market well during the market declines.

Regarding respective portfolio of different fund groups, there are some evidences that some fund groups possess more superior market timing abilities than the other fund groups. The timing coefficient obtained from these two different models consistently indicate the Hong Kong equity funds, US equity funds, and Asia excluding Japan equity funds possess inferior market timing performance.

Regarding the market timing abilities of individual equity funds, in contrast to the previous findings for the market timing performance of US mutual funds, the proportion of individual Hong Kong MPF equity funds with negative timing coefficients is lower. The market timing models employed in this study, T-M and H-M models, may successfully capture the market timing ability in the fund managers because the funds that possess superior market timing ability are shown to have higher traditional Jensen alpha presented in chapter 3 than the alpha value found by the market-timing models; those have inferior market timing ability shows lower value of Jensen alpha. Negative association between the Jensen alpha measure and market timing performance measure is found which is consistent with findings previously documented.

This study also examined the effect of incorporating lagged economic information variables into the detection of existence of market timing ability, from the view that a managed portfolio strategy using only readily available public economic information does not imply abnormal return. The conditional timing model is found to have higher explanatory power given by larger adjusted R^2. Conditional models may be considered as more appropriate for evaluating market timing abilities of equity fund managers. When the market timing models were controlled by public information variables, more funds were found exhibiting inferior market timing ability except the US equity funds although two statistical tests, paired t-test and Wilcoxon z-test employed to test the difference between the unconditional and conditional versions of T-M and H-M timing coefficients show that the timing coefficients found by the conditional version are not significantly less than those found by unconditional version except the European equity funds. The decrease in the market timing coefficients agrees with the assumption that the fund managers usually respond rationally to the public information and adjust accordingly, the conditional model will then control for this and worse market timing performance is expected. Furthermore, the positive and significant market-timing effects found by the unconditional models are generally no longer significant when conditional models are being used. This may be due to the strong predictive power of the conditional variables introduced in this study. It seems that this study succeeds in showing support for the better conditional models rather than the unconditional models as originally claimed.

Finally, the T-M and H-M model were subjected to specification test by adding a higher order term of market returns. The augmented market timing models were found to fit a large portion of our sample equity funds, which provide additional evidence of the inadequacy of the currently employed market timing models – T-M and H-M. It seems there is ample room for further research on higher moment market timing models.

CHAPTER 6 CONCLUSION AND IMPLICATIONS

6.1 Concluding remarks

There has been substantial amount of researches done on Hong Kong security and future markets; however, the research on mutual fund industry in Hong Kong is just emerging. The Mandatory Provident Fund scheme was implemented on December 1, 2000 and a large portion of Hong Kong workforce are mandatory to join the said scheme. The need for the research done on the performance of the constituent funds in the scheme becomes higher. This thesis represents the first comprehensive study on the performance (raw and risk-adjusted), persistence, and market timing ability of Hong Kong Mandatory Provident Funds (MPF) during the period 2001 – 2004. This thesis may also contribute the reference of performance study on pension funds in emerging mutual fund industries.

The performance of the MPF equity funds, especially the risk-adjusted performance, is evaluated in chapter 3. Both Jensen single-index alpha measure and Fama-French three-factor alpha measure indicate that the MPF constituent equity funds on average may outperform the benchmarks; however, if the performance was evaluated separately according to the fund groups, both measures consistently show that the US equity funds and Pacific-Basin excluding Japan equity funds underperform the market and the Japan equity funds possess the highest risk-adjusted returns. The economic information variables used in this study have additional explanatory power. The statistical tests may not reject the null hypothesis that there is no significant difference between the average traditional alpha and conditional alpha. The two additional factors in Fama-French three-factor model, *SMB* and *HML*, were found to have extra explanatory power and indicate the equity fund managers are tilted toward small and glamour stocks. The tracking errors indicate the four HSI tracking funds may not exactly replicate the returns of the target index and the magnitudes are relatively higher in every March during the sample period, which support the hypothesis that the tracking error is higher when the blue chips announce their previous year performance and the dividends. The Jensen model modified by the changes in exchange rate points out that most of the equity fund groups are affected by the changes in exchange rates. The study in chapter 3 may provide an implication to the MPF scheme participants that which class of equity funds usually outperforms the benchmark and a brief guideline on choosing category of equity funds.

MPF equity fund performance persistence is studied in chapter 4. Both nonparametric two-way contingency table approach and parametric regression analysis approach consistently indicate the previous annual performance, measured by raw returns, unconditional Jensen single-index alpha measure, conditional Jensen alpha measure, Fama-French alpha measure, and their rankings may be used to predict the current annual performance and performance rankings. The high-volatile equity funds were found to have stronger evidence of performance persistence and support the hypothesis that the high-volatile equity funds put more effort to persist their good performance. The US equity funds and European equity funds were found more frequent shifting from winner category to loser category. The evidences of performance persistence in shorter time horizon data using semi-annually and quarterly performance are weaker than those when using annual data were found. The evaluation of persistence of individual investment manager's performance indicates neither significant hot hand phenomenon nor significant cold hand phenomenon exists. The study in chapter 4 implies MPF mandate should be set up on an annual basis although this might ignore the fund shifting cost at such regular intervals. The extensions of the methodologies supplemented the nonparametric contingency table to evaluate persistence in performance for small samples may be applicable for other emerging regional fund industries.

Chapter 5 investigated the evidences of market timing ability of the equity fund managers. The currently used model, Treynor-Mazuy (T-M) and Hanriksson-Merton (H-M) models seem to capture the market-timing ability of the MPF equity funds. Negative association between the stock-selection ability measured by α and market-timing ability measured by γ was also found. The conditional version of the market-timing models indicate the public economic information variables have additional explanatory powers and may remove the number of significant market-timing coefficients, which implies the conditional version of market timing model is more appropriate than the unconditional models originally developed. The augmented version of T-M and H-M models by a higher order term seem to fit most of the data and implies an ample room for further research on higher moment market timing models.

6.2 Directions for future research

Three new categories of equity funds Korean equity funds, Asian excluding Japan excluding Hong Kong equity funds, and Greater China equity funds were introduced after the last year of the sample period 2004. This study can be extended to include these three categories as well as the sample period is extended beyond the calendar year 2004 in the future studies.

Section 2.2.3 summarizes the survivorship bias study. Some MPF may have ceased operations and are merged with the other funds that are managed by the same investment manager in the future. Certainly, the effect of survivorship bias on the Hong Kong MPF performance has been waiting to be examined.

Beside of using Jensen single-factor and Fama-French three-factor alpha measures to evaluate fund performance, there are some other alternative measures such as Portfolio Change Measure (PCM), Characteristic Selectivity (CS) measure, Characteristic Timing (CT) measure, and Average Style (AS) measure. Using these alternative measures to evaluate MPF constituent equity funds is fresh in academics and may be one of the interests in future research.

Much work remains to be done for the study on the performance of Hong Kong MPF. While actively equity funds are currently performing worse than the passively managed index funds, actively equity funds are still the predominant type of MPF equity funds. Identifying the characteristics of successful equity fund managers may be the focus of further study. The Hong Kong Mandatory Provident Fund Schemes Authority (MPFA) did not require fund trustees release their fund characteristics and their equity portfolios to the public until November 2005 and the investment managers consider such information are their confidential during the observation period 2001-2004. Due to the non-transparent operation requirements, the reason why some active managers are able to provide positive risk-adjusted performance and market timing ability while some cannot even though they are classified in the same fund group could not be searched for the observation period. As the operations become transparent and more information especially the fund operating characteristics such as fund cash flows, fund size, fund expense level, and turnover rates may be available in the future, more researches may be done on the determinants of the equity fund returns. Substantial amount of researches have been done in US on the determinants of mutual fund returns (summarized in section 2.2.6). Among these fund operating characteristics, the fund cash flows will be the major focus because some studies in US show that large unexpected cash flows to the funds may cause the fund managers make irrational investment decisions and thus influence the manager's stock selection skill.

The index funds really may have difficulty to replicate the benchmark index because most of the market indices do not take into account market fiction such as transaction costs and price pressure. Chiang (1998) identifies the factors transaction cost, composition changes of the target index, cash flows of the index funds, volatility in the target index, and the reinvestment of dividends may enlarge the tracking error. A study on the relationship between the tracking error and these factors may be interesting if the Hong Kong Mandatory Provident Fund Schemes Authority (HK MPFA) enforces the trustees to release the information about the fund cash flows in the future.

The study on determinants of the performance persistence is also the other major interest in further researches as well as the availability of the determinant data. Prior research has found that total net asset, age, expense ratio, turnover rate, and price to market-based earnings are the major determinants of fund performance persistence. Most of the prior studies focus on using linear regression to diagnose the relationship. Using logit model may be an option in mutual fund performance persistence studies.

Agarwal and Naik (2000) extend the performance persistence evaluation from the traditional two-period framework to a multi-period framework. However, the history of the Hong Kong MPF may not be long enough to perform such controversial methodology as a comparison with the currently employing two-period framework analysis. The multi-period analysis may be performed in the future if more quarterly and annual return figures are available on hand. It would be interesting to see if multi-period analysis of pension funds exhibits significantly different patterns compared to those observed in hedge funds and Asian hedge funds documented in Agarwal and Naik (2000) and Koh, Koh, and Teo (2003).

Large portions of funds included in the schemes of Hong Kong MPF are balanced funds, which are not the focus in this thesis. The balanced funds attempt to time the various markets within their prescribed target portions of equities although they are considered passive funds and have lower beta than equity funds. The balanced funds offered in the Hong Kong MPF schemes are classified as Lifestyle (>20 – 40% Equity), Lifestyle (>40 – 60% Equity), Lifestyle (>60 – 80% Equity), and Lifestyle (>80 – 100% Equity). The fund managers may invest in both bonds and equities, and adjust their portfolios monthly subject to the specified range of percentage of equities included in portfolios. All the current models used to evaluate the market timing ability adopt market portfolio of stocks as the benchmark only. However, most balanced funds attempt to time across various categories of investment vehicles such as stocks and bonds, modified T-M and H-M may be developed that allow to measure managers' ability to time across various classes of assets such as bonds and stocks, especially for balanced funds. A separate further study on the evaluation of market timing ability of the balanced funds to determine if these funds deliver on their promise is necessary in the further studies so that comparison of the stock selection and market timing ability could be made among the different types of funds.

Bollen and Busse (2001) demonstrate that when daily return data rather than monthly return data are used in the analysis, the percentages of the funds that possess significant positive or negative market timing ability become higher. The current database only provides monthly prices. Following them, a comparison of market timing ability using daily and monthly data may also be done in the future once the database is extended to provide daily closing prices.

Although there are some limitations in this study due to the availability of data, this study makes the first attempt to explore the new area, Hong Kong Mandatory Provident Fund (MPF) and may fit the niche that no academic researches done on this dataset. The findings in this thesis may provide lots of insight to the MPF scheme participants, fund trustees, investment managers, and fund mandates. Nevertheless, in this new retirement protection plan for all workforces in Hong Kong, there is much work remains to be done.

APPENDIX A: TABLES

Table 1.2.1: Employed population by the type of retirement scheme

	Proportions (%) as at					
Types of Retirement Scheme	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Joined MPF schemes	59	63	62	63	65	66
Joined other retirement schemes	23	23	22	21	20	18
Should join but have not yet joined any schemes	6	4	5	5	4	5
Not required to join any schemes	12	10	11	11	11	11

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

Table 1.2.2: Number of MPF schemes members

	Number of Members ('000) as at					
Types of Members	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Employers	240	228	231	227	228	232
Employees	1,816	1,808	1,793	1,819	1,952	2,061
Self-employed persons	326	353	399	370	361	373

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

Table 1.2.3: Numbers of MPF schemes by type

	Number as at					
Types of Schemes	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Master trust	47	47	45	44	44	42
Employer sponsored	2	2	2	2	2	2
Industry	2	2	2	2	2	2
Total	**51**	**51**	**49**	**48**	**48**	**46**

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

Table 1.2.4: Net asset values of MPF schemes by type

	Net Asset Values (HK $ million) as at					
Types of Schemes	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Master trust	15,534	40,965	57,372	94,026	120,521	159,860
Employer sponsored	54	274	457	2,275	2,820	3,465
Industry	106	886	1,475	740	975	1,289
Total*	**15,694**	**42,125**	**59,305**	**97,041**	**124,316**	**164,613**

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

* Figures may not sum to the total due to rounding.

Table 1.2.5: Numbers of approved constituent funds by type

	Number as at					
Types of Approved Constituent Funds	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Capital Preservation	51	51	49	48	47	46
Money Market	10	10	10	10	10	10
Guaranteed	40	40	39	37	36	36
Bond	8	8	15	19	18	18
Balanced	136	139	135	134	135	141
Equity	54	63	70	73	78	83
Total	**299**	**311**	**318**	**321**	**324**	**334**

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

Table 1.2.6: Net asset values of approved constituent funds by type

	Net Asset Values (HK $ million) as at					
Types of Approved Constituent Funds	**31/3/01**	**31/3/02**	**31/3/03**	**31/3/04**	**31/3/05**	**31/3/06**
Capital Preservation	2,201	6,291	10,685	15,185	19,204	23,126
Money Market	313	497	636	771	904	1,061
Guaranteed	3,536	8,273	11,961	15,893	19,020	21,933
Bond	107	245	482	1,151	1,568	1,939
Balanced	7,155	19,589	28,293	49,396	63,354	85,358
Equity	2,382	7,230	7,248	14,645	20,266	31,196
Total*	**15,694**	**42,125**	**59,305**	**97,041**	**124,316**	**164,613**

Source: Mandatory Provident Fund Schemes Authority, Hong Kong SAR Government

* Figures may not sum to the total due to rounding.

Table 1.2.7: MPF trustees as at the end of 2004

Name of Trustees		
Panel A: The trustees operating at the end of 2004		
American International Assurance Company (Trustee) Limited		
AXA China Region Trustees Limited		
Bank Consortium Trust Company Limited		
Bank of Communications Trustee Limited		
Bank of East Asia (Trustees) Limited		
BOCI–Prudential Trustee Limited		
China Life Trustees Limited		
CMG Asia Trustee Company Limited		
Dexia Trust Services Hong Kong Limited		
HSBC Institutional Trust Services (Asia) Limited		
HSBC Provident Fund Trustee (Hong Kong) Limited		
ING Pension Trust Limited		
Manulife Provident Funds Trust Company Limited		
MassMutual Trustees Limited		
MLC Trustee (Hong Kong) Limited		
Pacific Century Trustees Limited		
Principal Trust Company (Asia) Limited		
Panel B: The trustees stopped operating at the end of 2004 but still authorized by MPFA		
Cititrust Limited (Liquidated)		
Royal Bank of Canada Trust Company (Asia) Limited (Liquidated)		
Panel C: The trustees stopped operating and have been removed from the list of MPFA		
The Smart MPF		
Chamber CMG Choice (CCC)		
Panel D: The trustees merged with the existing trustees		
Trustees being merged →	Merged with	New scheme name
Polaris MPF →	HSBC Institutional Trust Services (Asia) Ltd	Kingsway MPF Master
Dao Hang MPF →	Principal Trust Company (Asia) Ltd	Series 500
DBS – Kwong On Bank →	Principal Trust Company (Asia) Ltd	Series B300

Table 1.2.8(A): MPF trustees, schemes, investment managers, and constituent funds (1)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
American International Assurance Company (Trustee) Limited	AIA-JF Comprehensive Retirement Benefit MPF Scheme	AIG Global Investment Corporation (HK) Limited	Capital Preservation Portfolio Guaranteed Portfolio AIG Funds Series MPF Capital Guaranteed Plus Policy
	AIA-JF Mandatory Provident Fund Scheme	AIG Global Investment Corporation (HK) Limited JF Asset Management Limited	Asian Equity Fund Balanced Portfolio Capital Preservation Portfolio Conservative Portfolio European Equity Fund Greater China Equity Fund Growth Portfolio Guaranteed Portfolio Hong Kong Equity Fund Japan Equity Fund North American Equity Fund AIG Fund Series JF SAR American Fund JF SAR Asian Fund JF SAR European Fund JF SAR Global Bond Fund JF SAR HK$ Bond Fund JF SAR Hong Kong Fund JF SAR Japan Fund MPF Capital Guaranteed Policy The Harbinger Fund
	AIA-JF Premium MPF Scheme	AIG Global Investment Corporation (HK) Limited JF Asset Management Limited	Asian Equity Fund Balanced Portfolio Capital Preservation Portfolio Conservative Portfolio European Equity Fund Greater China Equity Fund Growth Portfolio Guaranteed Portfolio Hong Kong Equity Fund Japan Equity Fund North American Equity Fund AIG Fund Series JF SAR American Fund JF SAR Asian Fund JF SAR European Fund JF SAR Global Bond Fund JF SAR HK$ Bond Fund JF SAR Hong Kong Fund JF SAR Japan Fund MPF Capital Guaranteed Policy The Harbinger Fund
AXA China Region Trustees Limited	Double Easy Mandatory Provident Fund	AXA China Region Trustees Limited	Double Easy Balanced Fund Double Easy Capital Preservation Fund Double Easy Cash Fund Double Easy Growth Fund Double Easy Guaranteed Fund Double Easy Stable Fund Double Easy Top Select Fund
	Elite Mandatory Provident Fund	AXA China Region Trustees Limited	Capital Preservation Fund Multi-manager Balanced Fund Multi-manager Growth Fund Multi-manager Hong Kong Equity Fund Multi-manager Stable Fund

Table 1.2.8(B): MPF trustees, schemes, investment managers, and constituent funds (2)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
Bank Consortium Trust Company Limited	Bank Consortium Industry Plan	Franklin Templeton Investments (Asia) Ltd. INVESCO Asia Ltd. Salomon Brothers Asset Management Asia Pacific Ltd. Schroder Investment Management (HK) Ltd.	BCT Asian Equity Fund BCT Balanced Fund BCT Capital Preservation Fund BCT Global Bond Fund BCT Global Equity Fund BCT Growth Fund BCT Hong Kong Equity Fund BCT Stable Fund CITI Investment Fund Series INVESCO Pooled Investment Fund Schroder MPF Asian Fund Templeton MPF Investment Fund
	Bank Consortium MPF Plan	Allianz Global Investors Hong Kong Limited Franklin Templeton Investments (Asia) Ltd. INVESCO Asia Ltd. Salomon Brothers Asset Management Asia Pacific Ltd. Schroder Investment Management (HK) Ltd.	BCT Asian Equity Fund BCT Balanced Fund BCT Capital Preservation Fund BCT Global Bond Fund BCT Global Equity Fund BCT Growth Fund BCT Hong Kong Equity Fund BCT Stable Fund CITI Investment Fund Series Schroder MPF Asian Fund Templeton MPF Investment Fund
	Jones Lang LaSalle Property Management Division Mandatory Provident Fund Scheme	China Insurance Group Assets Management Limited INVESCO Asia Ltd.	Jones Lang LaSalle Capital Preservation Fund Jones Lang LaSalle Guarantee Fund Tai Ping Retire-Easy Guarantee Fund
Bank of Communications Trustee Limited	BCOM Joyful Retirement MPF Scheme	BCOM Finance (Hong Kong) Limited	BCOM Guaranteed Fund BCOM Joyful Capital Preservation Fund
	BCOM Prosperous Retirement MPF Scheme	BCOM Finance (Hong Kong) Limited	BCOM Balanced Fund BCOM Prosperous Capital Preservation Fund BCOM Stable Growth Fund Schroder MPF Umbrella Fund
Bank of East Asia (Trustees) Limited	BEA (MPF) Industry Scheme	East Asia Asset Management Company Limited	BEA (Industry Scheme) Balanced Fund BEA (Industry Scheme) Capital Preservation Fund BEA (Industry Scheme) Growth Fund BEA (Industry Scheme) Stable Fund BEA Capital Growth Fund
	BEA (MPF) Master Trust Scheme	East Asia Asset Management Company Limited	BEA (MPF) Balanced Fund BEA (MPF) Capital Preservation Fund BEA (MPF) Growth Fund BEA (MPF) Long Term Guaranteed Fund BEA (MPF) Stable Fund BEA Capital Growth Fund Principal Guaranteed Umbrella Fund

Table 1.2.8(C): MPF trustees, schemes, investment managers, and constituent funds (3)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
BOCI-Prudential Trustee Limited	BOC-Prudential Easy-Choice Mandatory Provident Fund Scheme	BOCI-Prudential Asset Management Limited	BOC-Prudential Balanced Fund BOC-Prudential Bond Fund BOC-Prudential Capital Preservation Fund BOC-Prudential Global Equity Fund BOC-Prudential Growth Fund BOC-Prudential Hong Kong Equity Fund BOC-Prudential Stable Fund BOC-Prudential Unit Trust Fund
China Life Trustees Limited	China Life Master Trust Scheme	China Life Trustees Limited	China Life Balanced Fund China Life Capital Preservation Fund China Life Growth Fund China Life Guaranteed Return Fund
	Tai Ping Retire-Easy MPF Master Trust Scheme	China Life Trustees Limited	Tai Ping Retire-Easy Balanced Fund Tai Ping Retire-Easy Capital Preservation Fund Tai Ping Retire-Easy Capital Stable Fund Tai Ping Retire-Easy Growth Fund Tai Ping Retire-Easy Guarantee Fund
CMG Asia Trustee Company Limited	CMG Rainbow 65	First State Investments (Hong Kong) Limited	CMG Balanced Portfolio Fund CMG Capital Preservation Fund CMG Fixed Income Fund CMG Hong Kong Equity Fund CMG Progressive Growth Fund CMG Stable Income Fund

Table 1.2.8(D): MPF trustees, schemes, investment managers, and constituent funds (4)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
Dexia Trust Services Hong Kong Limited	SHKP MPF Employer Sponsored Scheme	Nexus Investment Management Ltd.	Dresdner Stable Growth Fund Fidelity Balanced Fund Fidelity Stable Growth Fund HSBC Capital Stable Fund New-Alliance Global Balanced Fund SHKP MPF Fund Standard Chartered Capital Preservation Fund – SHKP Standard Chartered Career Average Guaranteed Fund – SHKP
	Standard Chartered MPF Plan – Advanced	Nexus Investment Management Ltd.	CITI Balanced Fund CITI Conservative Fund CITI Hong Kong Equities Fund Dresdner RCM Balanced Fund Dresdner RCM Capital Stable Fund Dresdner RCM Growth Fund Fidelity Balanced Fund Fidelity Capital Stable Fund Fidelity Growth Fund HSBC MPF "A" – Balanced Fund HSBC MPF "A" – Hong Kong Equity Fund HSBC MPF "A" – Stable Fund INVESCO Global Balanced Fund INVESCO Global Equities Fund INVESCO MPF Bond Fund Merrill Lynch Flexible Balanced Fund Merrill Lynch Flexible Bond Plus Fund Merrill Lynch Flexible Equity Plus Fund Schroder MPF Asian Fund Schroder MPF Balanced Fund Schroder MPF HK Dollar Fixed Income Fund Standard Chartered Balanced Fund Standard Chartered Capital Preservation Fund Standard Chartered Career Average Guaranteed Fund Standard Chartered Growth Fund Standard Chartered Stable Fund Templeton MPF Asian Balanced Fund Templeton MPF Global Bond Fund Templeton MPF Global Equity Fund
	Standard Chartered MPF Plan – Basic	Nexus Investment Management Ltd.	Standard Chartered Balanced Fund Standard Chartered Capital Preservation Fund Standard Chartered Career Average Guaranteed Fund – Basic Standard Chartered Growth Fund – Basic Standard Chartered Stable Fund – Basic

Table 1.2.8(E): MPF trustees, schemes, investment managers, and constituent funds (5)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
HSBC Institutional Trust Services (Asia) Limited	Dresdner RCM MPF Plan	Allianz Global Investors Hong Kong Limited	Absolute Return Fund Asian Fund Balanced Fund Capital Preservation Fund Capital Stable Fund Growth Fund Hong Kong Fund Stable Growth Fund Dresdner RCM Choice Fund
	Fidelity Retirement Master Trust	Fidelity Investments Management (Hong Kong) Limited	Balanced Fund Capital Preservation Fund Capital Stable Fund Global Equity Fund Growth Fund Hong Kong Bond Fund Hong Kong Equity Fund Stable Growth Fund World Bond Fund Fidelity Global Investment Fund
	INVESCO Strategic MPF Scheme	INVESCO Asia Limited	Balanced Fund Capital Preservation Fund Capital Stable Fund Global Bond Fund Growth Fund Guaranteed Fund Hong Kong Equity Fund INVESCO Pooled Investment Fund Principal Guaranteed Umbrella Fund
	Kingsway MPF Master Trust	Kingsway Fund Management Limited	Kingsway Asia Pacific (Excl. HK) Fund Kingsway Capital Preservation Fund Kingsway Global Diversification Fund Kingsway Hong Kong SAR Fund Kingsway Korea Fund Kingsway Funds
	Manager Elite Master Trust	Allianz Global Investors Hong Kong Limited AXA Investment Managers HKSAR Ltd. Fidelity Investments Management (HK) Ltd. INVESCO Asia Ltd. Schroder Investment Management (HK) Ltd.	AXA Balanced Fund BNP Capital Preservation Fund Dresdner RCM Balanced Fund Fidelity Balanced Fund INVESCO Balanced Fund Managed Capital Stable Fund Managed Growth Fund Managed Stable Growth Fund Schroder Balanced Fund Dresdner RCM Choice Fund Fidelity Global Investment Fund INVESCO Pooled Investment Fund Schroder MPF Umbrella Fund
	New-Alliance Mandatory Provident Fund Scheme	New-Alliance Asset Management (Asia) Limited	Capital Growth Fund Capital Preservation Fund Global Balanced Fund Income Fund New-Alliance Umbrella Fund

Table 1.2.8(F): MPF trustees, schemes, investment managers, and constituent funds (6)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
HSBC Provident Fund Trustee (Hong Kong) Limited	Dresdner RCM MPF Master Trust	Allianz Global Investors Hong Kong Limited	Balanced Fund Capital Preservation Fund Capital Stable Fund Growth Fund Stable Growth Fund Dresdner RCM Choice Fund
	Hang Seng Mandatory Provident Fund – Supertrust	HSBC Provident Fund Trustee (Hong Kong) Limited	Balanced Fund Capital Preservation Fund Growth Fund Guaranteed Fund Hang Seng Index Tracking Fund HSBC MPF Fund Series "A" MPF Guaranteed Fund
	Hang Seng Mandatory Provident Fund – Supertrust Plus	HSBC Provident Fund Trustee (Hong Kong) Limited	Asian Equity Fund Balanced Fund Capital Preservation Fund European Equity Fund Growth Fund Guaranteed Fund Hang Seng Index Tracking Fund Hong Kong Equity Fund North American Equity Fund Stable Growth Fund HSBC MPF Fund Series "A" MPF Guaranteed Fund
	HSBC Mandatory Provident Fund – Supertrust	HSBC Provident Fund Trustee (Hong Kong) Limited	Balanced Fund Capital Preservation Fund Growth Fund Guaranteed Fund Hang Seng Index Tracking Fund HSBC MPF Fund Series "A" MPF Guaranteed Fund
	HSBC Mandatory Provident Fund – Supertrust Plus	HSBC Provident Fund Trustee (Hong Kong) Limited	Asian Equity Fund Balanced Fund Capital Preservation Fund European Equity Fund Growth Fund Guaranteed Fund Hang Seng Index Tracking Fund Hong Kong Equity Fund North American Equity Fund Stable Growth Fund HSBC MPF Fund Series "A" MPF Guaranteed Fund
	Schroder MPF Master Trust	Schroder Investment Management (HK) Ltd	Schroder MPF Asian Portfolio Schroder MPF Balanced Investment Portfolio Schroder MPF Capital Guaranteed Portfolio Schroder MPF Capital Preservation Portfolio Schroder MPF Capital Stable Portfolio Schroder MPF Growth Portfolio Schroder MPF HK Dollar Fixed Income Portfolio Schroder MPF Hong Kong Portfolio Schroder MPF International Portfolio Schroder MPF Stable Growth Portfolio ING MPF Capital Guaranteed Policy Schroder MPF Umbrella Fund

Table 1.2.8(G): MPF trustees, schemes, investment managers, and constituent funds (7)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
ING Pension Trust Limited	ING MPF Master Trust Basic Scheme	ING Pension Trust Ltd	ING MPF Basic scheme Balanced Growth Portfolio ING MPF Basic Scheme Capital Guaranteed Portfolio ING MPF Basic Scheme Capital Preservation Portfolio ING MPF Basic Scheme Hong Kong Equity Portfolio ING MPF Basic Scheme International Equity Portfolio ING MPF Basic Scheme Stable Growth Portfolio ING MPF Capital Guaranteed Policy ING MPF Capital Preservation Policy ING MPF Hong Kong Equities Policy Schroder MPF Umbrella Fund Templeton MPF Investment Funds
	ING MPF Master Trust Comprehensive Scheme	ING Pension Trust Ltd	ING MPF Comprehensive Scheme Asian Equity Portfolio ING MPF Comprehensive Scheme Balanced Growth Portfolio ING MPF Comprehensive Scheme Capital Guaranteed Portfolio ING MPF Comprehensive Scheme Capital Preservation Portfolio ING MPF Comprehensive Scheme Growth Portfolio ING MPF Comprehensive Scheme Hong Kong Equity Portfolio ING MPF Comprehensive Scheme International Equity Portfolio ING MPF Comprehensive Scheme Stable Growth Portfolio ING MPF Comprehensive Scheme Stable Portfolio ING MPF Asian Equities Policy ING MPF Capital Guaranteed Policy ING MPF Capital Preservation Policy ING MPF Hong Kong Equities Policy Schroder MPF Umbrella Fund Templeton MPF Investment Funds

Table 1.2.8(H): MPF trustees, schemes, investment managers, and constituent funds (8)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
Manulife Provident Funds Trust Company Limited	Manu-lifestyle (MPF) Scheme	Manulife Provident Funds Trust Company Limited	Manulife MPF Aggressive Fund Manulife MPF Capital Preservation Fund Manulife MPF Growth Fund Manulife MPF Interest Fund Manulife MPF Stable Fund
	Manulife Global Select (MPF) Scheme	Manulife Provident Funds Trust Company Limited	Manulife MPF Aggressive Fund Manulife MPF Capital Preservation Fund Manulife MPF European Equity Fund Manulife MPF Fidelity Growth Fund Manulife MPF Fidelity Stable Growth Fund Manulife MPF Growth Fund Manulife MPF Hong Kong Bond Fund Manulife MPF Hong Kong Equity Fund Manulife MPF Interest Fund Manulife MPF International Bond Fund Manulife MPF International Equity Fund Manulife MPF Japan Equity Fund Manulife MPF North American Equity Fund Manulife MPF Pacific Asia Equity Fund Manulife MPF Stable Fund
MassMutual Trustees Limited	Mass Mandatory Provident Fund Scheme	Franklin Templeton Investments (Asia) Limited	Asian Balanced Fund Capital Preservation Fund Global Bond Fund Global Equity Fund Global Growth Fund Global Stable Fund Guaranteed Growth Fund
MLC Trustees (Hong Kong) Limited	MLC MPF Master Trust Scheme	MLC Trustees (Hong Kong) Limited	Balanced Fund Capital Preservation Fund Growth Fund Templeton Global Equity Fund
Pacific Century Trustees Limited	PCI Master Trust MPF Scheme	Pacific Century Trustees Limited	PCI Capital Preservation Fund PCI Fixed Income Fund PCI Global Balanced Fund PCI Hong Kong Fund

Table 1.2.8(I): MPF trustees, schemes, investment managers, and constituent funds (9)

Name of Trustees	Registered Schemes	Investment Managers	Constituent Funds
Principal Trust Company (Asia) Limited	Eagle Star MPF Scheme – Advance Planner	Principal Asset Management Company (Asia) Limited	Eagle Star Accumulation Fund Eagle Star Capital Preservation Fund Eagle Star Global Growth Fund Eagle Star Guarantee Fund Eagle Star HK Dollar Savings Fund
	Eagle Star MPF Scheme – Security Planner	Principal Asset Management Company (Asia) Limited	Eagle Star Capital Preservation Fund Eagle Star Guarantee Fund Eagle Star HK Dollar Savings Fund
	Principal MPF Scheme Series 200	Principal Asset Management Company (Asia) Limited	Principal Capital Preservation Fund Principal HK Dollar Savings Fund Principal Long Term Guaranteed Fund
	Principal MPF Scheme Series 500	Principal Fund Management (Hong Kong) Limited	Aggressive Growth Fund Balanced Growth Fund Capital Preservation Fund Guaranteed Fund Stable Growth Fund
	Principal MPF Scheme Series 600	Principal Asset Management Company (Asia) Limited	Principal Capital Preservation Fund Principal Global Growth Fund Principal HK Dollar Savings Fund Principal Long Term Accumulation Fund Principal Long Term Guaranteed Fund
	Principal MPF Scheme Series 800	Principal Asset Management Company (Asia) Limited	Principal Asian Equity Fund Principal Capital Guaranteed Fund Principal Capital Preservation Fund Principal Global Growth Fund Principal HK Dollar Savings Fund Principal International Bond Fund Principal International Equity Fund Principal Long Term Accumulation Fund Principal Long Term Guaranteed Fund Principal Stable Yield Fund Principal US Dollar Savings Fund Principal US Equity Fund
	Principal MPF Scheme Series B300	Principal Asset Management Company (Asia) Limited	Principal Balanced Fund Principal Capital Preservation Fund Principal Conservative Fund Principal Growth Fund Principal International Bond Fund Principal Long Term Guaranteed Fund Principal US Equity Fund
	Zurich-Chinese Bank MPF Scheme – Premier	Principal Asset Management Company (Asia) Limited	Zurich-Chinese Bank Capital Preservation Fund Zurich-Chinese Bank Guarantee Fund Zurich-Chinese Bank HK Dollar Savings Fund

	Zurich-Chinese Bank MPF Scheme – Premier Deluxe	Principal Asset Management Company (Asia) Limited	Zurich-Chinese Bank Accumulation Fund Zurich-Chinese Bank Asian Equity Fund Zurich-Chinese Bank Capital Guarantee Fund Zurich-Chinese Bank Capital Preservation Fund Zurich-Chinese Bank Global Growth Fund Zurich-Chinese Bank Guarantee Fund Zurich-Chinese Bank HK Dollar Savings Fund Zurich-Chinese Bank International Bond Fund Zurich-Chinese Bank International Equity Fund Zurich-Chinese Bank Stable Yield Fund Zurich-Chinese Bank US Dollar Savings Fund Zurich-Chinese Bank US Equity Fund

Table 1.2.9: Classifications of funds and the respective benchmark specified by HKIFA

Classifications	Benchmarks
Balanced Funds	
Lifestyle (20 – 40% equity)	Watson Wyatt Composite Benchmark (20 – 40% equity)
Lifestyle (40 – 60% equity)	Watson Wyatt Composite Benchmark (40 – 60% equity)
Lifestyle (60 – 80% equity)	Watson Wyatt Composite Benchmark (60 – 80% equity)
Lifestyle (80 – 100% equity)	Watson Wyatt Composite Benchmark (80 – 100% equity)
Equity Funds	
HK Equity	FTSE MPF Hong Kong
US Equity	FTSE MPF USA (35% HK$ Hedged)
Japanese Equity	FTSE MPF Japan (35% HK$ Hedged)
Asia Ex Japan Equity	FTSE MPF Asia Pacific ex Japan, NZ & Australia
Pacific Basin Ex Japan Equity	FTSE MPF Asia Pacific ex Japan (35% HK$ Hedged)
European Equity	FTSE MPF Europe (35% HK$ Hedged)
Global Equity	FTSE MPF All-World (35% HK$ Hedged)
Bond Funds	
Global Bond	Citigroup WGBI (35% HK$ Hedged)
Hong Kong Dollar Bond	HSBC Hong Kong Bond Index
Money Market Funds	
Hong Kong Money Market	MPFA Prescribed Savings Rate
US Dollar Money Market	US 1 Month T-Bill Rate (35% HK$ Hedged)
Capital Preservation Funds	MPFA Prescribed Savings Rate
Guaranteed Return Funds	AIA-JF CRB MPF-GTD PF

Table 1.2.10: The structure of the benchmark indices

Benchmark Indices	No of Stocks	Full Market Cap (US $million)	Investible Market Cap (US $million)
FTSE MPF Hong Kong	159	917,805	356,846
FTSE MPF USA (35% HK$ Hedged)	634	11,947,320	11,526,042
FTSE MPF Japan (35% HK$ Hedged)	481	2,864,992	1,950,200
FTSE MPF Asia Pacific ex Japan, NZ & Australia	554	1,715,650	965,369
FTSE MPF Asia Pacific ex Japan (35% HK$ Hedged)	691	2,312,616	1,478,328
FTSE MPF Europe (35% HK$ Hedged)	570	7,966,958	6,795,517
FTSE MPF All-World (35% HK$ Hedged)	2595	26,352,670	22,858,811

Source: FTSE The Index Company

Table 3.3.1(1): Numbers of constituent equity funds with complete data by type

	Number of constituent funds as at							
Fund Groups	**31/3/01**	**31/6/01**	**31/9/01**	**31/12/01**	**31/3/02**	**31/6/02**	**31/9/02**	**31/12/02**
HKEQ	14	15	15	15	17	17	17	17
USEQ	5	5	5	5	7	7	7	7
ASEQ	7	7	7	7	7	7	7	7
JPEQ	1	1	1	1	3	3	3	3
PBEQ	1	2	2	2	2	2	2	2
EUEQ	3	3	3	3	5	5	5	5
GBEQ	11	11	11	11	11	11	11	11
Total	**42**	**44**	**44**	**44**	**52**	**52**	**52**	**52**

Table 3.3.1(2): Numbers of constituent equity funds with complete data by type (Continued)

	Number of constituent funds as at							
Fund Groups	**31/3/03**	**31/6/03**	**31/9/03**	**31/12/03**	**31/3/04**	**31/6/04**	**31/9/04**	**31/12/04**
HKEQ	19	20	21	21	21	21	21	22
USEQ	7	7	7	8	8	8	8	8
ASEQ	7	7	7	7	7	7	9	10
JPEQ	3	3	3	3	3	3	3	3
PBEQ	2	2	2	2	2	2	2	2
EUEQ	5	5	5	5	5	5	5	5
GBEQ	13	14	15	16	16	16	16	16
Total	**56**	**58**	**60**	**62**	**62**	**62**	**64**	**66**

The numbers in the table are the number of equity funds in the respective portfolio as at the date shown on the column headings. The equity funds are separated into seven groups according to the classification scheme specified by the Hong Kong Investment Fund Association (HKIFA) as at December 2004. The fund group titles stand for: (1) HKEQ: Hong Kong Equity Funds; (2) USEQ: U.S. Equity Funds; (3) ASEQ: Asia excluding Japan Equity Funds; (4) JPEQ: Japan Equity Funds; (5) PBEQ: Pacific Basin excluding Japan Equity Funds; (6) EUEQ: European Equity Funds; and (7) GBEQ: Global Equity Funds. The portfolios of funds for each fund group are equally weighted of all the funds that existed during the period January 2001 to December 2004.

Table 3.3.2(1): List of schemes and constituent equity funds offered by the trustees as at 31/12/2004

Fund Groups	Registered Schemes - Constituent Funds
HKEQ	AIA-JF MPF Scheme – Hong Kong Equity Fund AIA-JF Premium MPF Scheme – Hong Kong Equity Fund Bank Consortium MPF Plan – Hong Kong Equity Fund Bank Consortium Industry Plan – Hong Kong Equity Fund BOC-Prudential Easy-Choice MPF Scheme – Hong Kong Equity Fund CMG Rainbow 65 – Hong Kong Equity Fund Dresdner RCM MPF Plan – Hong Kong Fund Fidelity Retirement Master Trust – Hong Kong Equity Fund HSBC Mandatory Provident Fund – Supertrust Plus - Hong Kong Equity Fund Hang Seng Mandatory Provident Fund – Supertrust Plus – Hong Kong Equity Fund HSBC Mandatory Provident Fund – Supertrust – Hang Seng Index Tracking Fund HSBC Mandatory Provident Fund – Supertrust Plus – Hang Seng Index Tracking Fund Hang Seng Mandatory Provident Fund – Supertrust – Hang Sent Index Tracking Fund Hang Seng Mandatory Provident Fund – Supertrust Plus – Hang Seng Index Tracking Fund ING MPF Master Trust Basic Scheme – Hong Kong Equities Policy ING MPF Master Trust Comprehensive Scheme – Hong Kong Equities Policy INVESCO Strategic MPF Scheme – Hong Kong Equity Fund Manulife Global Select (MPF) Scheme – Hong Kong Equity Fund PCI Master Trust MPF Scheme – Hong Kong Fund Standard Chartered MPF Plan – Advanced – CITI Hong Kong Equities Fund Standard Chartered MPF Plan – Advanced – HSBC MPF “A” – Hong Kong Equity Fund Schroder MPF Master Trust – Hong Kong Portfolio
USEQ	AIA-JF MPF Scheme – North American Equity Fund AIA-JF Premium MPF Scheme – North American Equity Fund HSBC Mandatory Provident Fund – Supertrust Plus - North American Equity Fund Hang Seng Mandatory Provident Fund – Supertrust Plus – North American Equity Fund Manulife Global Select (MPF) Scheme – North American Equity Fund Principal MPF Scheme Series B300 – US Equity Fund Principal MPF Scheme Series 800 – US Equity Fund Zurich-Chinese Bank MPF Scheme – Premier Deluxe – US Equity Fund
ASEQ	Bank Consortium MPF Plan – Asian Equity Fund Bank Consortium Industry Plan – Asian Equity Fund Dresdner RCM MPF Plan – Asian Fund HSBC Mandatory Provident Fund – Supertrust Plus - Asian Equity Fund Hang Seng Mandatory Provident Fund – Supertrust Plus - Asian Equity Fund ING MPF Master Trust Comprehensive Scheme – Asian Equity Portfolio Principal MPF Scheme Series 800 – Asian Equity Fund Standard Chartered MPF Plan – Advanced – Schroder MPF Asian Fund Schroder MPF Master Trust – Asian Portfolio Zurich-Chinese Bank MPF Scheme – Premier Deluxe - Asian Equity Fund
JPEQ	AIA-JF Mandatory Provident Fund Scheme – Japan Equity Fund AIA-JF Premium MPF Scheme – Japan Equity Fund Manulife Global Select (MPF) Scheme – Japan Equity Fund
PBEQ	Kingsway MPF Master Trust – Asia Pacific (Excl. HK) Fund Manulife Global Select (MPF) Scheme – Pacific Asia Equity Fund
EUEQ	AIA-JF Mandatory Provident Fund Scheme – European Equity Fund AIA-JF Premium MPF Scheme – European Equity Fund HSBC Mandatory Provident Fund – Supertrust Plus – European Equity Fund Hang Seng Mandatory Provident Fund – Supertrust Plus – European Equity Fund Manulife Global Select (MPF) Scheme – European Equity Fund

Table 3.3.2(2): List of schemes and constituent equity funds offered by the trustees as at 31/12/2004 (Continued)

Fund Groups	Registered Schemes - Constituent Funds
GBEQ	Double Easy Mandatory Provident Fund – Top Select Fund Bank Consortium Industry Plan – Global Equity Fund Bank Consortium MPF Plan – Global Equity Fund BOC-Prudential Easy-Choice MPF Scheme – Global Equity Fund Fidelity Retirement Master Trust – Fidelity Global Investment Fund ING MPF Master Trust Basic Scheme – International Equity Portfolio ING MPF Master Trust Comprehensive Scheme – International Equity Portfolio Manulife Global Select (MPF) Scheme – International Equity Fund Mass Mandatory Provident Fund Scheme – Global Equity Fund MLC MPF Master Trust Scheme – Templeton Global Equity Fund Principal MPF Scheme Series 800 – International Equity Fund Standard Chartered MPF Plan – Advanced – Dresdner RCM Growth Fund Standard Chartered MPF Plan – Advanced – NVESCO Global Equities Fund Standard Chartered MPF Plan – Advanced – Templeton MPF Global Equity Fund Schroder MPF Master Trust – International Portfolio Zurich-Chinese Bank MPF Scheme – Premier Deluxe – International Equity Fund

Table 3.3.3: Descriptive statistics of monthly returns for fund style categories

Fund Groups	Mean return (%)	Standard deviation	Maximum	Minimum
HKEQ	0.83	0.94	2.81	0.02
USEQ	-0.13	0.52	1.06	-0.51
ASEQ	1.20	0.87	3.03	0.34
JPEQ	0.80	0.68	1.25	0.01
PBEQ	0.40	0.05	0.44	0.37
EUEQ	0.28	0.81	1.15	-0.65
GBEQ	0.53	0.88	2.15	-0.38

The 66 equity funds are separated into seven fund groups according to the classification scheme specified by the Hong Kong Investment Fund Association (HKIFA), where the fund group titles stand for the following fund groups: (1) HKEQ: Hong Kong Equity Funds; (2) USEQ: U.S. Equity Funds; (3) ASEQ: Asia excluding Japan Equity Funds; (4) JPEQ: Japan Equity Funds; (5) PBEQ: Pacific Basin excluding Japan Equity Funds; (6) EUEQ: European Equity Funds; and (7) GBEQ: Global Equity Funds. The portfolio of funds for each fund group is equally weighted of all the funds that existed during the period January 2001 to December 2004. The numbers in the table are monthly returns in percentage rates per month. The monthly return of every fund group portfolio is the average of the monthly returns of the equity funds in that group. The mean return for each fund group is the average of the monthly returns of respective fund group portfolio over the period January 2001 to December 2004. The standard deviation measures the spread of the monthly returns of respective fund group portfolio.

Table 3.3.4(1): An overview of MPF equity fund quarter performance (2001 – 2002)

Fund Groups	Measures	2001 Q1	2001 Q2	2001 Q3	2001 Q4	2002 Q1	2002 Q2	2002 Q3	2002 Q4
HKEQ	Mean return (%)	-11.50	2.88	-26.07	14.22	-2.38	-2.85	-15.50	1.81
	Mean excess return	-12.15	2.23	-26.50	14.11	-2.43	-2.90	-15.55	1.79
USEQ	Mean return (%)	-16.84	5.50	-17.65	8.54	-2.24	-15.28	-18.53	5.86
	Mean excess return	-17.49	4.85	-18.08	8.43	-2.29	-15.33	-18.58	5.84
ASEQ	Mean return (%)	-9.86	2.02	-22.92	25.37	10.99	-5.81	-16.71	2.13
	Mean excess return	-10.51	1.37	-23.35	25.26	10.94	-5.86	-16.76	2.11
JPEQ	Mean return (%)	-3.78	3.46	-23.51	-3.67	2.51	3.87	-14.78	-4.37
	Mean excess return	-4.43	2.81	-23.94	-3.78	2.46	3.82	-14.83	-4.39
PBEQ	Mean return (%)	-12.42	4.64	-20.17	14.97	12.11	-1.80	-20.30	-1.03
	Mean excess return	-13.07	3.99	-20.60	14.86	12.06	-1.85	-20.35	-1.05
EUEQ	Mean return (%)	-13.87	0.04	-16.28	8.51	-0.16	-5.33	-24.26	6.98
	Mean excess return	-14.52	-0.61	-16.71	8.40	-0.21	-5.38	-24.31	6.96
GBEQ	Mean return (%)	-11.29	0.67	-16.44	9.40	0.09	-10.17	-18.85	5.91
	Mean excess return	-11.94	0.02	-16.87	9.29	0.04	-10.22	-18.90	5.89

Table 3.3.4(2): An overview of MPF equity fund quarter performance (2003 – 2004)

Fund Groups	Measures	2003 Q1	2003 Q2	2003 Q3	2003 Q4	2004 Q1	2004 Q2	2004 Q3	2004 Q4
HKEQ	Mean return (%)	-5.35	11.63	17.93	11.49	3.84	-5.07	8.81	9.20
	Mean excess return	-5.35	11.63	17.93	11.49	3.84	-5.07	8.81	9.20
USEQ	Mean return (%)	-3.67	13.42	2.05	10.42	1.22	0.27	-2.81	8.38
	Mean excess return	-3.67	13.42	2.05	10.42	1.22	0.27	-2.81	8.38
ASEQ	Mean return (%)	-7.20	17.32	14.34	11.52	6.99	-10.31	5.33	9.97
	Mean excess return	-7.20	17.32	14.34	11.52	6.99	-10.31	5.33	9.97
JPEQ	Mean return (%)	-9.26	15.48	19.34	8.49	15.48	-2.11	-7.76	9.48
	Mean excess return	-9.26	15.48	19.34	8.49	15.48	-2.11	-7.76	9.48
PBEQ	Mean return (%)	-8.27	15.03	13.38	13.23	4.23	-10.15	3.62	10.06
	Mean excess return	-8.27	15.03	13.38	13.23	4.23	-10.15	3.62	10.06
EUEQ	Mean return (%)	-11.40	19.02	2.75	16.27	0.35	1.46	0.89	12.30
	Mean excess return	-11.40	19.02	2.75	16.27	0.35	1.46	0.89	12.30
GBEQ	Mean return (%)	-7.50	15.54	5.87	12.82	2.78	-1.06	-0.09	11.27
	Mean excess return	-7.50	15.54	5.87	12.82	2.78	-1.06	-0.09	11.27

The 66 equity funds are separated into seven fund groups according to the classification scheme specified by the Hong Kong Investment Fund Association (HKIFA). The portfolios of funds for each fund group are equally weighted of all the funds that existed during the period January 2001 to December 2004. The numbers in the table are quarterly returns in percentage rates per quarter. The quarterly return of every fund group portfolio is the average of the quarterly returns of the equity funds in that group as at the specified quarter.

Table 3.3.5: An overview of MPF equity fund annual performance (2001 – 2004)

Fund Groups	Measures	2001	2002	2003	2004
HKEQ	Mean return (%)	-20.32	-18.92	35.75	16.79
	Mean excess return	-22.50	-19.09	35.74	16.77
USEQ	Mean return (%)	-20.46	-30.19	22.22	7.06
	Mean excess return	-22.64	-30.36	22.21	7.04
ASEQ	Mean return (%)	-5.39	-9.40	35.98	11.90
	Mean excess return	-7.57	-9.57	35.97	11.88
JPEQ	Mean return (%)	-18.68	-11.02	33.37	7.77
	Mean excess return	-20.86	-11.19	33.36	7.75
PBEQ	Mean return (%)	-27.50	-12.77	34.05	15.09
	Mean excess return	-29.68	-12.94	34.04	15.07
EUEQ	Mean return (%)	-21.59	-22.76	26.65	15.00
	Mean excess return	-23.77	-22.93	26.64	14.98
GBEQ	Mean return (%)	-17.66	-23.02	26.95	12.90
	Mean excess return	-19.84	-23.19	26.94	12.88

The 66 equity funds are separated into seven fund groups according to the classification scheme specified by the Hong Kong Investment Fund Association (HKIFA). The portfolio of funds for each fund group is equally weighted of all the funds that existed during the period January 2001 to December 2004. The numbers in the table are annual returns in percentage rates per year. The annual return of every fund group portfolio is the average of the annual returns of the equity funds in that group as at the end of the specified year.

Table 3.4.1: Measures of performance: Traditional Jensen measure

Fund Group	Regression output	α	β	F-statistic	Adj. R^2
Panel A					
HKEQ	Coefficient t-statistic	0.002 5.176*	0.944 118.927*	14143.53*	0.941
USEQ	Coefficient t-statistic	-0.002 -3.348*	1.003 89.169*	7951.19*	0.961
ASEQ	Coefficient t-statistic	0.001 1.425	0.948 63.931*	4087.21*	0.920
JPEQ	Coefficient t-statistic	0.003 2.180**	1.110 42.594*	1814.214*	0.941
PBEQ	Coefficient t-statistic	-0.002 -0.757	0.945 23.634*	558.55*	0.857
EUEQ	Coefficient t-statistic	0.002 2.506**	0.946 65.023*	4227.93*	0.953
GBEQ	Coefficient t-statistic	0.001 1.763***	0.946 66.440*	4414.31*	0.874
Panel B					
All funds	Coefficient t-statistic	0.001 4.351*	0.957 117.564*	31528.93*	0.923

Panel A and panel B report the regression estimates of the traditional Jensen measure, from the Jensen single-index model for the portfolios of equity funds in different fund groups and all-equity-fund portfolios respectively,. The intercept α is the measure of the traditional alpha that indicates superior performance if it is positive and the coefficient β is an unconditional beta from the following regression:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta\left(R_{m,t} - R_{f,t}\right) + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 3.4.2: Regression estimates of measures of performance: Conditional Jensen measure

Fund Group	Regression output	α	$b_{1,i}$	$b_{SAV,t}$	$b_{JAN,t}$	$b_{DIV,t}$	$b_{TERM,t}$	$b_{DEF,t}$	F-statistic	Adj. R^2
Panel A										
HKEQ	Coefficient	0.002	0.554	4.371	-0.149	6.975	3.640	3.657	2414.018*	0.943
	t-statistic	4.054*	3.394*	1.939***	-3.694*	2.055**	1.539	0.541		
USEQ	Coefficient	-0.001	0.708	7.343	0.218	1.118	3.072	9.201	1520.522*	0.966
	t-statistic	-1.848***	3.475*	2.356**	2.287**	0.240	1.010	0.908		
ASEQ	Coefficient	0.002	0.173	11.122	-0.340	13.812	12.095	-10.331	719.664*	0.924
	t-statistic	2.411**	0.552	2.526**	-4.010*	2.054**	2.684*	-0.865		
JPEQ	Coefficient t-	0.001	0.429	2.875	-0.212	7.967	8.488	12.914	320.075*	0.944
	statistic	0.968	0.856	0.412	-1.598	0.829	1.280	0.638		
PBEQ	Coefficient t-	-0.003	0.229	1.606	-0.436	4.311	10.634	29.603	103.652*	0.869
	statistic	-1.419	0.251	0.126	-1.390	0.227	0.816	0.949		
EUEQ	Coefficient t-	0.001	0.256	7.869	0.026	2.504	5.868	37.354	769.906*	0.957
	statistic	1.623	1.059	2.107**	0.343	0.482	1.477	3.100*		
GBEQ	Coefficient t-	0.001	0.479	3.342	0.268	1.618	6.787	18.866	767.342*	0.878
	statistic	0.901	1.798***	0.831	2.698*	0.286	1.643	1.517		
Panel B										
All Funds	Coefficient t-	0.001	0.473	5.111	-0.127	4.364	5.723	13.963	5351.751*	0.925
	statistic	2.504**	4.466*	3.394*	-4.299*	1.979**	3.708*	3.172*		

Panel A and panel B report the regression estimates of the conditional Jensen measure from the single-index model for the portfolios of equity funds in different fund groups and all-equity-fund portfolio respectively. The intercept α is the measure of the traditional alpha that indicates superior performance if it is positive and the coefficient β is an unconditional beta from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + b_{1,i}(R_{m,t} - R_{f,t}) + b'_{2,i}[Z_t(R_{m,t} - R_{f,t})] + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. The vector of information variables, Z, includes the 1-month MPFA saving rate, January dummy variable, HSI dividend yield, maturity spread, and quality spread; $b'_{2,i} = (b_{SAV}, b_{JAN}, b_{DIV}, b_{TERM}, b_{DEF})'$. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 3.4.3: Test for the differences between Jensen measures

	All funds (n=65)	HKEQ (n=21)	USEQ (n=8)	ASEQ (n=10)	JPEQ (n=3)	PBEQ (n=2)	EUEQ (n=5)	GBEQ (n=16)
Parametric test:								
t-statistic	-0.238	1.000	-1.323	-2.769	1.732	1.000	2.064	0.259
p-value (two-tailed)	0.813	0.329	0.227	0.022**	0.225	0.500	0.108	0.799
Nonparametric test:								
Wilcoxon *z*-statistic	-0.106	-0.670	-1.300	-2.214	-1.342	-1.000	-1.633	-0.241
p-value (two-tailed)	0.915	0.503	0.194	0.027**	0.180	0.317	0.102	0.810

The table presents the result of testing the hypothesis that the conditional Jensen measure is significantly different from the traditional Jensen measure of individual fund for the portfolio of all funds and respective portfolios of equity funds in different fund groups by parametric paired t-test and nonparametric Wilcoxon matched-pairs test. The null hypothesis is set to be $H_0 : \mu_{traditional\ \alpha} = \mu_{conditional\ \alpha}$ against the alternative $H_a : \mu_{traditional\ \alpha} \neq \mu_{conditional\ \alpha}$. Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 3.4.4: Test for proportions of positive alphas

Panel A

	All funds (n=65)	
	Traditional Alphas	**Conditional Alphas**
Number of positive alphas	37	38
Proportion	0.56	0.58
Asymptotic *z*-statistic	0.86	1.24
p-value (two-tailed)	0.389	0.215

The hypothesis that the number of positive traditional alphas and that of positive conditional alphas equal 50% of the total number of equity funds $(H_0 : p_{+\alpha} = 0.5)$ is tested by nonparametric binomial test. The test is conducted by comparing the probability of the observed distribution and the expected probability, and the test statistic is approximated by the asymptotic normal distribution.

Panel B

	All funds (n=65)
Mean difference of proportions	-0.02
Asymptotic *z*-statistic	-0.23
p-value (two-tailed)	0.259

The table presents the result of testing the hypothesis that that proportion of positive traditional Jensen alpha equal the proportion of positive conditional Jensen alpha $(H_0 : p_{+traditional\,\alpha} = p_{+conditional\,\alpha})$ by nonparametric two-sample binomial test. The test is conducted by comparing the distributions of the traditional Jensen alpha and the conditional Jensen alpha, and the test statistic is approximated by the asymptotic normal distribution.

Table 3.4.5: Test for difference in measures among different equity fund portfolios

	Traditional Alphas	Conditional Alphas
Parametric test:		
F-statistic	2.074***	3.544*
p-value	0.070***	0.005*
Nonparametric test:		
Kruskal-Wallis χ^2-statistic	16.169**	17.598*
p-value	0.013**	0.007*

The table presents the result of testing the hypothesis that the means of traditional and conditional Jensen alphas are same across different portfolios respectively $\left(H_0 : \mu_\alpha \text{ are same across different portfolios}\right)$ against the alternative $\left(H_a : \text{Not all } \mu_\alpha \text{ are same across different portfolios}\right)$ by parametric ANOVA *F*-test and nonparametric Kruskal-Wallis χ^2-test. Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 3.4.6: Measures of performance: Fama-French three-factor measure

Fund Group	Regression output	*α*	*β*	*s*	*h*	F-statistic	Adj. R^2
Panel A							
HKEQ	Coefficient	0.002	0.968	0.027	-0.062	4887.57*	0.943
	t-statistic	4.436*	109.145*	1.441	-5.649*		
USEQ	Coefficient	-0.002	1.007	-0.030	-0.025	2718.19*	0.962
	t-statistic	-3.841*	89.875*	-1.340	-2.202**		
ASEQ	Coefficient	0.001	0.960	0.026	-0.043	1372.47*	0.921
	t-statistic	1.114	58.175*	0.710	-2.056**		
JPEQ	Coefficient	0.004	1.101	0.093	0.062	655.13*	0.946
	t-statistic	2.877*	43.486*	1.659	2.287**		
PBEQ	Coefficient	-0.002	0.968	-0.164	0.016	190.31*	0.859
	t-statistic	-0.980	21.611*	-1.853***	0.334		
EUEQ	Coefficient	0.002	0.946	-0.024	0.007	1399.51*	0.953
	t-statistic	2.430**	63.211*	-0.695	0.424		
GBEQ	Coefficient	0.002	0.937	0.068	0.053	1550.72*	0.879
	t-statistic	2.645*	66.586*	2.562**	3.801*		
Panel B							
All funds	Coefficient	0.001	0.960	0.019	-0.011	10519.63*	0.924
	t-statistic	4.248*	168.859*	1.610	-1.716***		

Panel A and panel B report the regression estimates of the Fama-French three-factor measure from the three-index model for the portfolio of all equity funds and portfolios of different fund groups respectively. The intercept α is the measure of the Fama-French three-factor alpha that indicates superior performance if it is positive, the coefficient *β* measures the market risk, s measures the exposure to size risk and h measures the exposure to value risk from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + s \cdot SMB_t + h \cdot HML_t + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. *SMB* is the explanatory variable used to mimic the risk factor in returns related to size and defined as the difference between the average returns on small-stock portfolios and big-stock portfolios. *HML* is used to mimic the risk factor in returns related to value measured by book-to-market (B/M) ratios and defined as the difference between the average returns on stocks with high-B/M portfolios and low-B/M portfolios. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 3.4.7: Test for the differences between traditional single-factor Jensen and Fama-French 3-factor measures

	All funds (n=65)	HKEQ (n=22)	USEQ (n=8)	ASEQ (n=10)	JPEQ (n=3)	PBEQ (n=2)	EUEQ (n=5)	GBEQ (n=16)
Parametric test:								
t-statistic	1.092	1.618	3.211	1.029	-4.000	0.000	0.000	-5.000
p-value (two-tailed)	0.279	0.121	0.015**	0.330	0.057***	1.000	1.000	0.000

The table presents the result of testing the hypothesis that the Fama-French three-factor measure is significantly different from the traditional Jensen measure for the portfolio of all funds and respective portfolios of equity funds in different fund groups by parametric paired t-test and nonparametric Wilcoxon matched-pairs test. The null hypothesis is set to be $H_0 : \mu_{\text{Jensen}\,\alpha} = \mu_{\text{Fama-French}\,\alpha}$ against the alternative $H_0 : \mu_{\text{Jensen}\,\alpha} \neq \mu_{\text{Fama-French}\,\alpha}$. Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 3.4.8: Measures of performance: Conditional Fama-French three-factor measure

Fund Group	Regression output	α	$b_{1,i}$	$b_{1,i}^{SMB}$	$b_{1,i}^{HML}$	F-statistic	Adj. R^2
Panel A							
HKEQ	Coefficient	0.002	0.225	-1.183	0.307	865.54*	0.946
	t-statistic	3.690*	0.887	-2.252**	0.928		
USEQ	Coefficient	0.000	0.546	-0.761	0.351	517.71*	0.967
	t-statistic	0.109	1.944**	-1.312	1.149		
ASEQ	Coefficient	0.002	-0.164	0.947	0.360	256.75*	0.929
	t-statistic	1.774***	-0.355	0.947	0.576		
JPEQ	Coefficient	0.000	0.081	2.188	0.363	114.76*	0.948
	t-statistic	0.013	0.141	1.588	0.601		
PBEQ	Coefficient	-0.001	-1.124	-1.165	1.229	37.28*	0.875
	t-statistic	-0.234	-0.893	-0.490	0.861		
EUEQ	Coefficient	0.003	-0.300	-1.218	0.090	277.96*	0.960
	t-statistic	2.555**	-0.923	-1.413	0.201		
GBEQ	Coefficient	0.003	0.428	-1.247	-0.157	288.98*	0.891
	t-statistic	2.680*	1.236	-1.757***	-0.415		
Panel B							
All funds	Coefficient	0.002	0.294	-0.827	0.179	1843.25*	0.927
	t-statistic	5.841*	2.203**	-2.579**	1.048		

Panel A and panel B report part of the regression estimates of the conditional Fama-French three-factor measure for the portfolios of different fund groups and the portfolio including all equity funds respectively, from the three-index model. The regression estimates of all coefficients $b'_{2,i}Z_t$ are not shown here. The intercept α is the measure of the conditional Fama-French three-factor alpha that indicates superior performance if it is positive, the coefficients $b_{1,i}$, $b_{1,i}^{SMB}$ and $b_{1,i}^{HML}$ are average conditional betas with respect to the three factors from the following regression::

$$R_{i,t} - R_{f,t} = \alpha + (b_{1,i} + b_{2,i}Z_t)(R_{m,t} - R_{f,t}) + (b_{1,i}^{SMB} + b_{2,i}^{SMB}Z_t)SMB_t + (b_{1,i}^{HML} + b_{2,i}^{HML}Z_t)HML_t + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the tth month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. *SMB* is the explanatory variable used to mimic the risk factor in returns related to size and defined as the difference between the average returns on small-stock portfolios and big-stock portfolios. *HML* is used to mimic the risk factor in returns related to value measured by book-to-market (B/M) ratios and defined as the difference between the average returns on stocks with high-B/M portfolios and low-B/M portfolios. The vector of information variables, *Z*, includes the 1-month MPFA saving rate, January dummy variable, HSI dividend yield, maturity spread, and quality spread; $b'_{2,i} = (b_{SAV}, b_{JAN}, b_{DIV}, b_{TERM}, b_{DEF})'$. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 3.4.9: Regression estimates of measures of exchange-rate controlled performance of equity funds

Fund Group	Regression output	α	β_1	β_2	β_3	F-statistic	Adj. R^2
USEQ	Coefficient t-statistic	-0.002 -3.431*	1.002 60.140*	-0.604 -1.415	0.002 0.138	2652.16*	0.961
ASEQ	Coefficient t-statistic	0.002 1.627	0.973 26.713*	-0.267 -1.707***	-0.014 -0.376	1367.17*	0.921
JPEQ	Coefficient t-statistic	0.002 1.454	1.052 33.822*	0.180 3.351*	0.039 1.484	667.48*	0.947
PBEQ	Coefficient t-statistic	-0.002 -0.760	0.723 7.993*	0.344 1.516	0.180 2.399**	200.01*	0.865
EUEQ	Coefficient t-statistic	0.001 1.000	0.949 48.264*	0.150 4.416*	-0.010 -0.509	1536.62*	0.957
GBEQ	Coefficient t-statistic	-0.001 -0.728	0.873 40.090*	0.359 6.478*	0.042 2.395**	1608.04*	0.883

The table presents the results of the coefficients estimates of the Jensen measure controlled for changes in exchange rate for the respective portfolios of equity funds in different fund groups. The intercept α has the same interpretation as that of Jensen measure which measures the measure of the fund manager's stock selection ability, coefficient β_1 measures the sensitivity of the fund returns on the foreign market returns, coefficient β_2 measures if the changes in foreign exchange rate has significant effect on the fund return, and β_3 measures the degree of market integration to the Hong Kong stock market, which indicates the foreign country's stock market is segmented from the Hong Kong stock market and the foreign equity fund return is affected by the HK stock market return if it is statistically significant, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta_1 \cdot (R_{mf,t} - R_{f,t}) + \beta_2 \cdot R_{ex,t} + \beta_3 \cdot (R_{md,t} - R_{f,t})$$

$R_{ex,t}$ is the control variable added to capture the monthly changes in exchange rates which is compounded from daily changes and the daily changes are calculated by the following difference of natural logarithm $\left[\ln\left(\frac{X_j}{X_{j-1}}\right)\right]$,, where X_j is the HK dollar amount that one can exchange for each unit of foreign currency at day *j*, $R_{mf,t}$ denotes the return on foreign country's market portfolio measured by the foreign currency unit (i.e. not H.K. dollar hedged), and $R_{md,t}$ is the return on the Hong Kong market portfolio (the FTSE MPF Hong Kong Index). Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 3.4.10: Tracking error of MPF equity index funds: HSBC MPF and Hang Seng MPF – Hang Seng Index Tracking Funds

Panel A: Using absolute difference (AD) $(TE_{AD,p})$

n	Mean of AD $(TE_{AD,p})$	t-statistic	SD of AD	Min	Median	Max
48	**0.0033**	6.590*	0.0034	0.0001	0.0020	0.0171

Panel B: Using standard deviation of return differences $(TE_{SD,p})$

n	Mean	t-statistic	SD of differences	Annualized SD $(TE_{SD,p})$	Min	Median	Max
48	0.0016	2.531**	0.0045	**0.0155**	-0.0059	0.0003	0.0171

Panel C: Using CAPM model $(TE_{CAPM,p})$

n	SE of regression $(TE_{CAPM,p})$	α	β	R^2
48	**0.0110**	0.002	1.006	0.994

The table summarizes the tracking errors for all four Hang Seng Index tracking funds offered in the MPF schemes.

Panel A shows the result of using average absolute difference to find tracking error, which is given by $TE_{AD,i} = \frac{\sum_{t=1}^{n} |e_{i,t}|}{n}$, where $e_{i,t}$ is the difference between the returns of index funds and that of Hang Seng Index, $e_{i,t} = R_{i,t} - R_{b,t}$, $R_{i,t}$ is the return of equity index fund, $R_{b,t}$ is the return on the benchmark index *b* in period *t*, and *n* is number of periods. The t-statistic supplemented with the tracking error is the test statistic of the null hypothesis that the tracking error is not significantly different from zero, asterisks (*) indicate significant difference at 1% level, and (**) indicate significant difference at 5% level.

Panel B summarizes the result of using standard deviation of differences in returns to calculate tracking error as $TE_{SD,i} = \left[\sqrt{\frac{1}{n-1} \sum_{t=1}^{n} (e_{i,t} - \bar{e}_i)^2} \right] \sqrt{M}$, where *M* is the number of periods within a year, M will be 12 if monthly data are used. Column 3 presents the test statistic for the null hypothesis that the mean of raw differences is not significantly different from zero.

Panel C presents the result of tracking error which is defined as the standard error of regression of the following CAPM model:

$R_{i,t} = \alpha + \beta \cdot R_{b,t} + e_t$.

Table 3.4.11: Regression estimates to evaluate the seasonal effects in tracking error of MPF index funds: HSBC MPF and Hang Seng MPF – Hang Seng Index Tracking Funds

Panel A: Using absolute difference (AD)

	Jan (intercept)	**Feb**	**March**	**April**	**May**	**June**
Coefficient	0.002	-0.001	0.006	0.004	0.003	-0.001
t-statistic	1.330	-0.536	2.857*	2.048**	1.286	-0.345
	July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Coefficient	0.001	0.004	0.000	0.000	0.000	0.000
t-statistic	0.357	1.869***	-0.119	-0.060	0.214	-0.155
F-statistic	2.462**					

Panel B: Using raw differences

	Jan (intercept)	**Feb**	**March**	**April**	**May**	**June**
Coefficient	-0.001	0.001	0.009	0.008	0.006	0.000
t-statistic	-0.890	0.424	4.281*	3.480*	2.770*	0.057
	July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Coefficient	-0.001	0.007	0.003	0.000	0.004	0.000
t-statistic	-0.618	3.331*	1.167	0.034	1.740***	-0.126
F-statistic	5.705*					

The table presents the result of the seasonality test using regression analysis proposed by Tennenbaum & Fink (1994), which use eleven dummy variables (one month is used as a reference month) representing the 12 months of the year, to test whether the tracking error is different from some months than others. The regression models are as follow:

$$\left|e_{i,t}\right| = \alpha + \sum_{j=2}^{12} b_j D_j + \varepsilon_i \quad \text{for panel A and}$$

$$e_{i,t} = \alpha + \sum_{j=2}^{12} b_j D_j + \varepsilon_i \quad \text{for panel B.}$$

Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 4.4.1: Two-way contingency table – Ranked fund raw returns over successive 1-year intervals

PANEL A

		Subsequent Year 2002		
		Winners		Losers
Initial Year 2001	Winners	12 (57.14%)		9 (42.86%)
Total funds: 42				
New funds: 10	Losers	7 (33.33%)		14 (66.67%)
	Malkiel Z-Test on repeat winners:		Z = 0.6547	
	Malkiel Z-Test on repeat losers:		Z = 1.5275***	
	Cross Product Ratio Test:		Z = 1.5342	CPR = 2.6667
	Chi-square Test:		χ^2 = 2.4027	

		Subsequent Year 2003		
		Winners		Losers
Initial Year 2002	Winners	20 (76.92%)		6 (23.08%)
Total funds: 52				
New funds: 4	Losers	7 (26.92%)		19 (73.08%)
	Malkiel Z-Test on repeat winners:		Z = 2.7456*	
	Malkiel Z-Test on repeat losers:		Z = 2.3534*	
	Cross-Product Ratio Test:		Z = 3.4307*	CPR = 9.0476
	Chi-square Test:		χ^2 = 13.0193*	

		Subsequent Year 2004		
		Winners		Losers
Initial Year 2003	Winners	23 (79.31%)		6 (20.69%)
Total funds: 56				
New funds: 10	Losers	9 (33.33%)		18 (66.67%)
	Malkiel Z-Test on repeat winners:		Z = 3.1568*	
	Malkiel Z-Test on repeat losers:		Z = 1.7321**	
	Cross-Product Ratio Test:		Z = 3.3182*	CPR = 7.6667
	Chi-square Test:		χ^2 = 12.069*	

PANEL B

		Combined results		
		Winners in holding period		Losers in holding period
Combined results	Winners in evaluation period	55 (72.37%)		21 (27.63%)
Total funds: 150				
New funds: 24	Losers in evaluation period	23 (31.08%)		51 (68.92%)
	Malkiel Z-Test on repeat winners:		Z = 3.9001*	
	Malkiel Z-Test on repeat losers:		Z = 3.2549*	
	Cross-Product Ratio Test:		Z = 4.9000*	CPR = 5.8075
	Chi-square Test:		χ^2 = 25.6061*	

Winners and losers are ranked relative to the median raw return and determined over one-year period, and then ranked over the subsequent one-year periods. This provides three separate periods. Winners are defined as funds with returns above or equal median and losers are funds with returns below the median. WW and LL denote winners and losers in two consecutive periods. LW denotes losers in the first period and winners in the subsequent period. WL denotes winners in the first period and losers in the subsequent period.

Z-test of repeat winners: $Z = \frac{[WW - 0.5 * (WW + WL)]}{\sqrt{(WW + WL) * 0.5 * 0.5}}$;

Z-test of repeat losers: $Z = \frac{\left[LL - 0.5 * (LW + LL)\right]}{\sqrt{(LW + LL) * 0.5 * 0.5}}$;

Cross-Product Ratio = $\frac{(WW * LL)}{(WL * LW)}$ $\sigma_{\ln(CPR)} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}}$

Z-statistic of Cross-Product Ratio: $Z = \frac{\ln(CPR)}{\sigma_{\ln(CPR)}}$

Chi-square test: = $\frac{(WW - E_1)^2}{E_1} + \frac{(WL - E_2)^2}{E_2} + \frac{(LW - E_3)^2}{E_3} + \frac{(LL - E_4)^2}{E_4}$

where E_i is the expected number in each cell and are calculated as:

$E_1 = \frac{(WW + WL) \times (WW + LW)}{n}$; $E_2 = \frac{(WW + WL) \times (WL + LL)}{n}$

$E_3 = \frac{(LW + LL) \times (WW + LW)}{n}$; $E_4 = \frac{(LW + LL) \times (WL + LL)}{n}$.

Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.2: Two-way contingency table – Ranked fund risk-adjusted returns (Jensen alpha) over successive 1-year intervals

PANEL A

		Subsequent Year 2002		
		Winners		Losers
Initial Year 2001 Total funds: 42 New funds: 10	Winners	13 (59.09%)		9 (40.91%)
	Losers	6 (30.00%)		14 (70.00%)
	Malkiel Z-Test on repeat winners:		Z = 0.8528	
	Malkiel Z-Test on repeat losers:		Z = 1.7889**	
	Cross Product Ratio Test:		Z = 1.8613**	CPR = 3.3704
	Chi-square Test:		χ^2 = 3.5788***	

		Subsequent Year 2003		
		Winners		Losers
Initial Year 2002 Total funds: 52 New funds: 4	Winners	17 (65.38%)		9 (34.62%)
	Losers	9 (34.62%)		17 (65.38%)
	Malkiel Z-Test on repeat winners:		Z = 1.5689***	
	Malkiel Z-Test on repeat losers:		Z = 1.5689***	
	Cross-Product Ratio Test:		Z = 2.1818**	CPR = 3.5679
	Chi-square Test:		χ^2 = 4.9231**	

		Subsequent Year 2004		
		Winners		Losers
Initial Year 2003 Total funds: 56 New funds: 10	Winners	19 (67.86%)		9 (32.14%)
	Losers	12 (42.86%)		16 (57.14%)
	Malkiel Z-Test on repeat winners:		Z = 1.8898**	
	Malkiel Z-Test on repeat losers:		Z = 0.7559	
	Cross-Product Ratio Test:		Z = 1.8600**	CPR = 2.8148
	Chi-square Test:		χ^2 = 3.5406***	

PANEL B

		Combined results		
		Winners in holding period		Losers in holding period
Combined results Total funds: 150 New funds: 20	Winners in evaluation period	49 (64.47%)		27 (35.53%)
	Losers in evaluation period	27 (36.49%)		47 (63.51%)
	Malkiel Z-Test on repeat winners:		Z = 2.5236*	
	Malkiel Z-Test on repeat losers:		Z = 2.3250*	
	Cross-Product Ratio Test:		Z = 3.3809*	CPR = 3.1591
	Chi-square Test:		χ^2 = 11.7492*	

Like the raw returns, winners and losers are ranked relative to the median Jensen alpha and determined over one-year period, and then ranked over the subsequent one-year periods. This provides three separate periods. The definitions of winners and losers, the interpretations of WW, WL, LW, and LL, the formulae to compute the test statistics are same to the nonparametric persistence analysis on raw returns. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.3: Two-way contingency table – Ranked fund conditional risk-adjusted returns (conditional Jensen alpha) over successive 1-year intervals

PANEL A

		Subsequent Year 2002		
		Winners		Losers
Initial Year 2001 Total funds: 42 New funds: 10	Winners	14 (66.67%)		7 (33.33%)
	Losers	7 (33.33%)		14 (66.67%)
	Malkiel Z-Test on repeat winners:		Z = 1.5275***	
	Malkiel Z-Test on repeat losers:		Z = 1.5275***	
	Cross Product Ratio Test:		Z = 2.1176**	CPR = 4.0000
	Chi-square Test:		χ^2 = 4.6667**	

		Subsequent Year 2003		
		Winners		Losers
Initial Year 2002 Total funds: 52 New funds: 4	Winners	16 (53.33%)		14 (46.67%)
	Losers	10 (45.45%)		12 (54.55%)
	Malkiel Z-Test on repeat winners:		Z = 0.3651	
	Malkiel Z-Test on repeat losers:		Z = 0.4264	
	Cross-Product Ratio Test:		Z = 0.5608	CPR = 1.3714
	Chi-square Test:		χ^2 = 0.3152	

		Subsequent Year 2004		
		Winners		Losers
Initial Year 2003 Total funds: 56 New funds: 10	Winners	20 (71.43%)		8 (28.57%)
	Losers	9 (32.14%)		19 (67.86%)
	Malkiel Z-Test on repeat winners:		Z = 2.2678**	
	Malkiel Z-Test on repeat losers:		Z = 1.8898**	
	Cross-Product Ratio Test:		Z = 2.8582*	CPR = 5.2778
	Chi-square Test:		χ^2 = 8.6539*	

PANEL B

		Combined results		
		Winners in holding period		Losers in holding period
Combined results Total funds: 150 New funds: 20	Winners in evaluation period	50 (63.29%)		29 (36.71%)
	Losers in evaluation period	26 (36.62%)		45 (63.38%)
	Malkiel Z-Test on repeat winners:		Z = 2.3627*	
	Malkiel Z-Test on repeat losers:		Z = 2.2549**	
	Cross-Product Ratio Test:		Z = 3.2216*	CPR = 2.9841
	Chi-square Test:		χ^2 = 10.6420*	

Like the raw returns, winners and losers are ranked relative to the median conditional Jensen alpha and determined over one-year period, and then ranked over the subsequent one-year periods. This provides three separate periods. The definitions of winners and losers, the interpretations of WW, WL, LW, and LL, the formulae to compute the test statistics are same to the nonparametric persistence analysis on raw returns. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.4: Two-way contingency table – Ranked fund risk-adjusted returns (Fama-French three-factor alpha) over successive 1-year intervals

PANEL A

		Subsequent Year 2002		
		Winners		Losers
Initial Year 2001 Total funds: 42 New funds: 10	Winners	11 (52.38%)		10 (47.62%)
	Losers	8 (38.1%)		13 (61.90%)
	Malkiel Z-Test on repeat winners:		Z = 0.2182	
	Malkiel Z-Test on repeat losers:		Z = 1.0911	
	Cross Product Ratio Test:		Z = 0.9267	CPR = 1.7875
	Chi-square Test:		χ^2 = 0.8650	

		Subsequent Year 2003		
		Winners		Losers
Initial Year 2002 Total funds: 52 New funds: 4	Winners	15 (57.69%)		11 (42.31%)
	Losers	11 (42.31%)		15 (57.69%)
	Malkiel Z-Test on repeat winners:		Z = 0.7845	
	Malkiel Z-Test on repeat losers:		Z = 0.7845	
	Cross-Product Ratio Test:		Z = 1.1050	CPR = 1.8595
	Chi-square Test:		χ^2 = 1.2308	

		Subsequent Year 2004		
		Winners		Losers
Initial Year 2003 Total funds: 56 New funds: 10	Winners	15 (53.57%)		13 (46.43%)
	Losers	13 (46.43%)		15 (53.57%)
	Malkiel Z-Test on repeat winners:		Z = 0.3780	
	Malkiel Z-Test on repeat losers:		Z = 0.3780	
	Cross-Product Ratio Test:		Z = 0.5341	CPR = 1.3314
	Chi-square Test:		χ^2 = 0.2857	

PANEL B

		Combined results		
		Winners in holding period		Losers in holding period
Combined results Total funds: 150 New funds: 20	Winners in evaluation period	41 (54.67%)		34 (45.33%)
	Losers in evaluation period	32 (42.67%)		43 (57.33%)
	Malkiel Z-Test on repeat winners:		Z = 0.2095	
	Malkiel Z-Test on repeat losers:		Z = 0.1020	
	Cross-Product Ratio Test:		Z = 1.4666	CPR = 1.6204
	Chi-square Test:		χ^2 = 2.1615	

Like the raw returns, winners and losers are ranked relative to the median Fama-French three-factor alpha and determined over one-year period, and then ranked over the subsequent one-year periods. This provides three separate periods. The definitions of winners and losers, the interpretations of WW, WL, LW, and LL, the formulae to compute the test statistics are same to the nonparametric persistence analysis on raw returns. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.5: Regression estimates of last 1-year raw returns over successive 1-year intervals

Dependent Variable (Subsequent Year)	Independent Variable (Initial Year)	*b* Persistence Coefficient	t-statistic	p-value	R^2
Panel A					
2002	2001	0.402	3.345*	0.002	0.219
2003	2002	0.596	7.328*	0.000	0.518
2004	2003	0.444	5.484*	0.000	0.358
Panel B (Combined regression results)					
Holding period	Evaluation period	0.112	1.641***	0.100	0.018

OLS regression analysis is employed as a parametric approach to investigate the performance persistence of MPF equity funds. The persistence coefficient *b* is the regression coefficient of the regression model, which is a regression of year *t+1* performance on year *t* performance, estimated by OLS technique. The parametric regression model is represented as:

$$R_{i,t+1} = a + b \cdot R_{i,t} + e_i$$

where R_i is the raw returns, a and b are constants with *e* as a disturbance term. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.6: Regression estimates of last 1-year risk-adjusted returns (Jensen alpha) over successive 1-year intervals

Dependent Variable (Subsequent Year)	Independent Variable (Initial Year)	*b* Persistence Coefficient	t-statistic	p-value	R^2
Panel A					
2002	2001	0.138	1.294	0.203	0.040
2003	2002	0.330	2.679*	0.010	0.126
2004	2003	0.385	3.724*	0.000	0.204
Panel B (Combined regression results)					
Holding period	Evaluation period	0.200	3.106*	0.002	0.061

Like the raw returns, OLS regression analysis is employed as a parametric approach to investigate the risk-adjusted performance (measured by traditional Jensen alpha) persistence of MPF equity funds. The persistence coefficient *b* is the regression coefficient of the regression model, which is a regression of period *t*+1 risk-adjusted performance measured by Jensen alpha with period t risk-adjusted performance, estimated by OLS technique. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.7: Regression estimates of last 1-year risk-adjusted returns (conditional Jensen alpha) over successive 1-year intervals

Dependent Variable (Subsequent Year)	Independent Variable (Initial Year)	*b* Persistence Coefficient	t-statistic	p-value	R^2
Panel A					
2002	2001	0.063	0.757	0.453	0.014
2003	2002	0.072	0.755	0.454	0.011
2004	2003	0.399	2.986*	0.004	0.142
Panel B (Combined regression results)					
Holding period	Evaluation period	0.104	1.933***	0.055	0.025

Like the raw returns, OLS regression analysis is employed as a parametric approach to investigate the risk-adjusted performance (measured by conditional Jensen alpha) persistence of MPF equity funds. The persistence coefficient *b* is the regression coefficient of the regression model, which is a regression of period *t*+1 risk-adjusted performance measured by conditional Jensen alpha with period *t* risk-adjusted performance, estimated by OLS technique. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.8: Regression estimates of last 1-year risk-adjusted returns (Fama-French three-factor alpha) over successive 1-year intervals

Dependent Variable (Subsequent Year)	Independent Variable (Initial Year)	*b* Persistence Coefficient	t-statistic	p-value	R^2
Panel A					
2002	2001	0.131	1.330	0.191	0.042
2003	2002	0.363	2.651**	0.011	0.123
2004	2003	0.107	1.091	0.280	0.022
Panel B (Combined regression results)					
Holding period	Evaluation period	0.080	1.174	0.242	0.009

Like the raw returns, OLS regression analysis is employed as a parametric approach to investigate the risk-adjusted performance (measured by Fama-French three-factor alpha) persistence of MPF equity funds. The persistence coefficient *b* is the regression coefficient of the regression model, which is a regression of period *t*+1 risk-adjusted performance measured by Fama-French three-factor alpha with period t risk-adjusted performance, estimated by OLS technique. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.9: Spearman rank correlation coefficient - Persistence in annual raw return rankings

Current Year	Subsequent Year	r_s Spearman Rank Correlation Coefficient	Significance
Panel A (Individual annual periods)			
2001	2002	0.337**	0.029
2002	2003	0.683*	0.000
2003	2004	0.604*	0.000
Mean SRCC		*0.541*	
Standard deviation of SRCC		*0.181*	
Panel B (Combined regression results)			
Holding period	Evaluation period	0.003	0.975

Spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in fund performance rank. The funds are ranked in ascending order based on their raw returns and the *SRCC* is computed over one-year period, and then compute the *SRCC* over the subsequent one-year period. SRCC (r_s) may be computed as follow:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

where d is the difference in the raw return ranks. The value of r_s is between -1 and +1, with +1 indicating perfect positive correlation and -1 indicating perfect negative correlation. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.4.10: Spearman rank correlation coefficient - Persistence in annual risk-adjusted return (Jensen alpha) rankings

Current Year	Subsequent Year	r_s Spearman Rank Correlation Coefficient	Significance
Panel A (Individual annual periods)			
2001	2002	0.155	0.326
2002	2003	0.365*	0.008
2003	2004	0.466*	0.000
Mean SRCC		*0.329*	
Standard deviation of SRCC		*0.159*	
Panel B (Combined regression results)			
Holding period	Evaluation period	0.250*	0.002

Like the raw return, spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in risk-adjusted fund performance (Jensen alpha) rank. The funds are ranked in ascending order based on their risk-adjusted returns measured by Jensen alpha and the SRCC is computed over one-year period, and then compute the *SRCC* over the subsequent one-year period.

Table 4.4.11: Spearman rank correlation coefficient - Persistence in annual risk-adjusted return (conditional Jensen alpha) rankings

Current Year	Subsequent Year	r_s Spearman Rank Correlation Coefficient	Significance
Panel A (Individual annual periods)			
2001	2002	0.232	0.139
2002	2003	0.074	0.601
2003	2004	0.439*	0.001
Mean SRCC		*0.248*	
Standard deviation of SRCC		*0.183*	
Panel B (Combined regression results)			
Holding period	Evaluation period	0.239*	0.003

Like the raw return, spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in risk-adjusted fund performance (conditional Jensen alpha) rank. The funds are ranked in ascending order based on their risk-adjusted returns measured by conditional Jensen alpha and the *SRCC* is computed over one-year period, and then compute the *SRCC* over the subsequent one-year period. Spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in fund performance rank.

Table 4.4.12: Spearman rank correlation coefficient - Persistence in annual risk-adjusted return (Fama-French three-factor alpha) rankings

Current Year	Subsequent Year	r_s Spearman Rank Correlation Coefficient	Significance
Panel A (Individual annual periods)			
2001	2002	0.297***	0.056
2002	2003	0.351**	0.011
2003	2004	0.173	0.204
Mean SRCC		*0.274*	
Standard deviation of SRCC		*0.091*	
Panel B (Combined regression results)			
Holding period	Evaluation period	0.092	0.261

Like the raw return, spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in risk-adjusted fund performance (Fama-French three-factor alpha) rank. The funds are ranked in ascending order based on their risk-adjusted returns measured by Fama-French three-factor alpha and the *SRCC* is computed over one-year period, and then compute the *SRCC* over the subsequent one-year period. Spearman rank correlation coefficient (*SRCC*) is used to investigate the persistence in fund performance rank.

Table 4.5.1: Two-way contingency table –Ranked fund raw return over successive 1-year intervals; Grouped by high-volatility funds, low-volatility funds

Panel A (Individual annual periods)		High-Volatility		Low-Volatility		Total Sample	
		Subsequent Year		Subsequent Year		Subsequent Year	
		2002		2002		2002	
		Winners	Losers	Winners	Losers	Winners	Losers
Initial Year 2001	Winners	3	3	9	6	12	9
	Losers	7	9	0	5	7	14
		2003		2003		2003	
		Winners	Losers	Winners	Losers	Winners	Losers
Initial Year 2002	Winners	9	3	11	3	20	6
	Losers	7	9	0	10	7	19
		2004		2004		2004	
		Winners	Losers	Winners	Losers	Winners	Losers
Initial Year 2003	Winners	16	0	7	6	23	6
	Losers	5	7	4	11	9	18

Panel B (Combined results of successive annual periods)		Combined results in holding period		Combined results in holding period		Combined results in holding period	
		Winners	Losers	Winners	Losers	Winners	Losers
Combined results in evaluation period	Winners	28 (82.35%)	6 (17.65%)	27 (64.29%)	15 (35.71%)	55 (72.37%)	21 (27.63%)
	Losers	19 (43.18%)	25 (56.82%)	4 (13.33%)	26 (86.67%)	23 (31.08%)	51 (68.92%)

Winners and losers are ranked relative to the median raw return and determined over one-year period, and then ranked over the subsequent one-year periods. This provides three separate periods. The funds are split into the high- and low-volatile funds by using median variance of all equity funds over the entire period 2001-2004 as the benchmark. A fund is classified as high-volatile fund if its variance of annual returns is higher than or equal to the median variance of all equity funds. A fund is classified as low-volatile fund if its variance of annual returns is lower than the median variance of all equity funds.

Table 4.5.2: Regression estimates of last 1-quarter performance over successive 1-quarter performance

	Dependent Variable	Independent Variable	*b* Persistence Coefficient	t-statistic	p-value	R^2
Raw return	Holding period	Evaluation period	-0.008	-0.241	0.809	0.000
Risk-adjusted return	Holding period	Evaluation period	0.030	0.924	0.356	0.001

Quarterly raw returns and risk-adjusted returns (Jensen alpha measures) are used to investigate the evidences of performance persistence. The quarterly risk-adjusted returns are found by running the Jensen single-factor model on the monthly returns of equity funds and those of benchmark indices in each quarter. Like the analogous analysis for performance over 1-year intervals, OLS regression which is a regression of quarter *t+1* performance with quarter *t* performance is employed to investigate the performance persistence. The regression coefficient *b* of the regression model is the measure of persistence. The parametric regression model is represented as:

$$R_{i,t+1} = a + b \cdot R_{i,t} + e_i$$

where R_i is the raw returns, a and b are constants with e as a disturbance term. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.5.3: Regression estimates of last semi-year performance over successive semi-year performance

	Dependent Variable	Independent Variable	*b* Persistence Coefficient	t-statistic	p-value	R^2
Raw return	Holding period	Evaluation period	0.196	3.839*	0.000	0.039
Adjusted return	Holding period	Evaluation period	-0.032	-1.399	0.163	0.005

Like the investigation of quarterly performance persistence, semi-annual raw returns and risk-adjusted returns (Jensen alpha measures) are also used to investigate the evidences of performance persistence. The semi-annually risk-adjusted returns are found by running the Jensen single-factor model on the semi-annually returns of equity funds and those of benchmark indices in each semi-year. Similar to the analogous analysis for performance over 1-quarter intervals, OLS regression which is a regression of semi-year *t+1* performance with semi-year *t* performance is employed to investigate the performance persistence. The regression coefficient *b* of the regression model is the measure of persistence. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.5.4: Regression estimates of last monthly performance over successive monthly performance

	Dependent Variable	Independent Variable	*b* (Persistence Coeff.)	t-statistic	p-value	R^2
Raw return	Holding period	Evaluation period	0.196	10.264*	0.000	0.039

Like the investigation of quarterly performance persistence, monthly raw return is also used to investigate the evidences of performance persistence. Similar to the analogous analysis for performance over 1-quarter intervals, OLS regression which is a regression of month *t+1* performance with month *t* performance is employed to investigate the performance persistence. The regression coefficient *b* of the regression model is the measure of persistence. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level.

Table 4.5.5: Two-way contingency table – Ranked raw returns of portfolios over successive months from Jan 2001 to December 2004

Fund group	Initial Month	Subsequent Month Win	Subsequent Month Lose	Repeat Winners %	Repeat Winning *z*-stat.	Repeat Losers %	Repeating Losing *z*-stat.
HKEQ	Win	14	14	50.00	0.0000	31.58	-1.6059†††
	Lose	13	6				
USEQ	Win	10	11	47.62	-0.2182	57.69	0.7845
	Lose	11	15				
ASEQ	Win	18	12	60.00	1.0954	35.29	-1.2127
	Lose	11	6				
JPEQ	Win	18	11	62.07	1.2999***	33.33	-1.4142†††
	Lose	12	6				
PBEQ	Win	21	9	70.00	2.1909**	47.06	-0.2425
	Lose	9	8				
EUEQ	Win	11	12	47.83	-0.2085	45.83	-0.4082
	Lose	13	11				
GBEQ	Win	15	12	55.56	0.5774	40.00	-0.8944
	Lose	12	8				

The table presents the number of repeat-winning, repeat-losing and reversal times of each fund group during the period January 2001 to December 2004. The 66 equity funds are separated into seven fund groups according to the classification scheme specified by the Hong Kong Investment Fund Association (HKIFA), where the fund group titles stand for the following fund groups: (1) HKEQ: Hong Kong Equity Funds; (2) USEQ: U.S. Equity Funds; (3) ASEQ: Asia excluding Japan Equity Funds; (4) JPEQ: Japan Equity Funds; (5) PBEQ: Pacific Basin excluding Japan Equity Funds; (6) EUEQ: European Equity Funds; and (7) GBEQ: Global Equity Funds. The portfolio of funds for each fund group is equally weighted of all the funds that existed during the period January 2001 to December 2004. The average monthly raw return of the funds in the same group is used as a proxy of monthly performance of that portfolio. Winners and losers are ranked relative to the median raw return of all seven portfolios and determined over one-month period, and then ranked over the subsequent one-month periods. This provides 47 separate periods. The definitions of winners and losers, the interpretations of WW, WL, LW, and LL, the formulae to compute the test statistics are same to the nonparametric persistence analysis on annual raw returns. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level. Dagger (†) indicate significant reversal at 1% level, (††) indicate significant reversal at 5% level, and (†††) indicate significant reversal at 10% level.

Table 4.5.6: Two-way contingency table – Ranked MPF trustee and investment manager returns over successive months from Jan 2001 to December 2004

Trustees	Investment Managers	Initial Month	Subsequent Month Win	Subsequent Month Lose	Repeat Winners %	Repeat Winning *z*-stat.	Repeat Losers %	Repeating Losing *z*-stat.
AIA-JF	AIG	Win	6	10	37.50	-1.0000	42.11	-0.6882
		Lose	11	8				
AXA	AXA	Win	8	12	40.00	-0.8944	55.56	0.5774
		Lose	12	15				
BCT	BCT	Win	5	7	41.67	-0.5774	46.15	-0.2774
		Lose	7	6				
BOCI-Prudential	BOCI-Prudential	Win	1	6	14.29	-1.8898††	50.00	0.0000
		Lose	6	6				
CMG	First State	Win	20	11	64.52	1.6164***	25.00	-2.0000††
		Lose	12	4				
Dexia (Standard Chartered MPF)	Nexus	Win	19	9	67.86	1.8898**	47.37	-0.2294
		Lose	10	9				
HSBC MPF	HSBC MPF	Win	10	17	37.04	-1.3472†††	20.00	-2.6833†
		Lose	16	4				
HSBC MPF	Hang Seng MPF	Win	10	17	37.04	-1.3472†††	20.00	-2.6833†
		Lose	16	4				
HSBC MPF	Schroder	Win	14	13	51.85	0.1925	40.00	-0.8944
		Lose	12	8				
HSBC Institutional	Kingsway	Win	25	7	78.13	3.1820*	53.85	0.2774
		Lose	6	7				
HSBC Institutional	Fidelity	Win	6	15	28.57	-1.9640††	42.31	-0.7845
		Lose	15	11				
HSBC Institutional	INVESCO	Win	6	6	50.00	0.0000	44.44	-0.3333
		Lose	5	4				
HSBC Institutional	DRESDNER	Win	0	1	0.00	-1.0000	50.00	0.0000
		Lose	1	1				
ING	ING	Win	12	12	50.00	0.0000	47.83	-0.2085
		Lose	12	11				
Manulife	Manulife	Win	4	11	26.67	-1.8074††	62.50	1.4142***
		Lose	12	20				
Mass Mutual	Franklin Templeton & Salomon Brothers	Win	3	7	30.00	-1.2649	30.00	-1.2649
		Lose	7	3				
MLC	MLC	Win	10	14	41.67	-0.8165	34.78	-1.4596†††
		Lose	15	8				
PCI	PCI	Win	9	14	39.13	-1.0426	43.48	-0.6255
		Lose	13	10				
Principal	Principal 800	Win	10	15	40.00	-1.0000	31.82	-1.7056††
		Lose	15	7				
Principal	Principal B300 (*DBS-Kwong On*)	Win	3	3	50.00	0.0000	60.00	0.6325
		Lose	4	6				
Principal	Zurich-Chinese Bank	Win	8	13	38.10	-1.0911	50.00	0.0000
		Lose	13	13				

The table presents the number of repeat-winning, repeat-losing and reversal times of each investment manager that is providing equity funds over the period from January 2001 to December 2004. The average monthly raw return of the equity funds provided by the same investment manager is used as a proxy of monthly performance of that manager. Winners and losers are ranked relative to the median raw return of all investment managers and determined over one-month period, and then ranked over the subsequent one-month periods. This provides 47 separate periods. The definitions of winners and losers, the interpretations of WW, WL, LW, and LL, the formulae to compute the test statistics are same to the other nonparametric persistence analysis. Asterisks (*) indicate significant persistence at 1% level, (**) indicate significant persistence at 5% level, and (***) indicate significant persistence at 10% level. Dagger (†) indicate significant reversal at 1% level, (††) indicate significant reversal at 5% level, and (†††) indicate significant reversal at 10% level.

Table 4.5.7: Comparison of conditional and unconditional repeating winning and repeat losing percentages

Trustees	Investment Managers	Repeat Winners %	Overall W-W %	Overall W-W % Rank	Repeat Losers %	Overall L-L %	Overall L-L % Rank
HSBC Institutional	Kingsway	78.13	55.56	1	53.85	15.55	16
Dexia (Standard Chartered MPF)	Nexus	67.86	40.43	3	47.37	19.15	12
CMG	First State	64.52	42.55	2	25.00	8.51	19
HSBC MPF	Schroder	51.85	29.79	4	40.00	17.02	14
HSBC Institutional	INVESCO	50.00	28.57	5	50.00	33.33	3
ING	ING	50.00	25.53	6	47.83	23.40	8
Principal	Principal B300 (previously *DBS-Kwong On*)	50.00	18.75	13	60.00	37.50	2
BCT	BCT	41.67	20.00	11	46.15	24.00	7
MLC	MLC	41.67	21.28	7	34.78	17.02	14
AXA	AXA	40.00	17.02	15	55.56	31.91	4
Principal	Principal 800	40.00	21.28	7	50.00	27.66	6
PCI	PCI	39.13	19.57	12	43.48	21.74	11
Principal	Zurich-Chinese Bank	38.10	17.02	15	31.82	14.89	18
AIA-JF	AIG	37.50	17.14	14	42.11	22.86	10
HSBC MPF	HSBC MPF	37.04	21.28	7	20.00	8.51	19
HSBC MPF	Hang Seng MPF	37.04	21.28	7	20.00	8.51	19
Mass Mutual	Franklin Templeton & Salomon Brothers	30.00	15.00	17	30.00	15.00	17
HSBC Institutional	Fidelity	28.57	12.77	18	44.44	19.05	13
Manulife	Manulife	26.67	8.51	19	62.50	42.55	1
BOCI-Prudential	BOCI-Prudential	14.29	5.26	20	50.00	31.58	5
HSBC Institutional	DRESDNER	0.00	0.00	21	42.31	23.40	8

The table presents the comparison of the percentages of repeat-winners and repeat-losers with those of win-win and lose-lose for each investment manager. The investment managers are ranked in the order of repeat-winner percentage shown in the column 3, while columns 4 and 7 show the percentages of win-win and lose-lose, and columns 5 and 8 show the respective ranking of investment managers in terms of their win-win and lose-lose percentage.

Repeat-winners % = $\frac{WW}{WW+WL}$ Repeat-losers % = $\frac{LL}{LW+LL}$

Overall W-W % = $\frac{WW}{WW+WL+LW+LL}$ Overall L-L % = $\frac{LL}{WW+WL+LW+LL}$

Table 5.4.1(a): Regression estimates of measures of market-timing: Unconditional Treynor and Mazuy (T-M) model

Fund Group	Regression output	α	β (Beta)	γ (Timing coefficient)	F-statistic	Adj. R^2
Panel A						
HKEQ	Coefficient	0.003	0.940	-0.131	7076.74*	0.941
	t-statistic	4.839*	110.225*	-1.235		
USEQ	Coefficient	0.000	0.977	-0.617	4128.807*	0.962
	t-statistic	-0.750	74.154*	-3.585*		
ASEQ	Coefficient	0.001	0.947	-0.041	2038.16*	0.920
	t-statistic	1.286	58.515*	-0.238		
JPEQ	Coefficient	0.001	1.105	0.898	928.76*	0.943
	t-statistic	0.339	42.690*	1.860***		
PBEQ	Coefficient	-0.004	0.989	0.804	285.44*	0.859
	t-statistic	-1.549	20.590*	1.613		
EUEQ	Coefficient	0.001	0.957	0.265	2127.52*	0.953
	t-statistic	1.301	59.303*	1.491		
GBEQ	Coefficient	0.000	0.965	0.454	2218.41*	0.874
	t-statistic	0.273	56.221*	1.926***		
Panel B						
All funds	Coefficient	0.001	0.960	0.084	15767.51*	0.923
	t-statistic	2.854*	162.162*	1.179		

Panel A and panel B report the regression estimates of the unconditional TM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta and the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot (R_{m,t} - R_{f,t})^2 + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 5.4.1(b): Number of funds with significant timing ability by unconditional T-M

	Significant at 10%		Significant at 5%		Significant at 1%	
Fund Group	Positive	Negative	Positive	Negative	Positive	Negative
HKEQ	0	0	0	0	0	1
USEQ	0	0	0	0	0	2
ASEQ	0	0	0	0	0	0
JPEQ	0	0	0	0	0	0
PBEQ	0	0	0	0	0	0
EUEQ	0	0	0	0	2	0
GBEQ	2	1	3	0	0	0
Total	**2**	**1**	**3**	**0**	**2**	**3**

The table presents the number of individual funds that have significant superior (positive) and inferior (negative) market-timing ability, investigated by unconditional T-M model.

Table 5.4.2(a): Regression estimates of measures of market-timing: Unconditional Henriksson and Merton (H-M) model

Fund Group	Regression output	α	β (Beta)	γ (Timing coefficient)	F-statistic	Adj. R^2
Panel A						
HKEQ	Coefficient t-statistic	0.004 4.631*	0.913 51.812*	-0.053 -1.933	7095.62*	0.941
USEQ	Coefficient t-statistic	0.000 0.218	0.930 34.788*	-0.114 -3.018*	4080.57*	0.962
ASEQ	Coefficient t-statistic	0.002 1.235	0.932 27.432*	-0.028 -0.528	2039.55*	0.920
JPEQ	Coefficient t-statistic	-0.001 -0.283	1.190 21.355*	0.165 1.625	921.70*	0.942
PBEQ	Coefficient t-statistic	-0.004 -1.006	1.006 10.414*	0.098 0.695	277.95*	0.856
EUEQ	Coefficient t-statistic	0.001 0.571	0.985 30.025*	0.063 1.312	2122.15*	0.953
GBEQ	Coefficient t-statistic	0.000 0.326	0.976 27.925*	0.046 0.919	2207.04*	0.874
Panel B						
All funds	Coefficient t-statistic	0.001 2.693*	0.956 78.698*	-0.002 -0.087	15758.48*	0.923

Panel A and panel B report the regression estimates of the unconditional HM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta and the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot [D \cdot (R_{m,t} - R_{f,t})] + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices, and D is the dummy variable equals -1 if $R_{m,t} - R_{i,t}$ is negative and 0 otherwise. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 5.4.2(b): Number of funds with significant timing ability by unconditional H-M

	Significant at 10%		Significant at 5%		Significant at 1%	
Fund Group	Positive	Negative	Positive	Negative	Positive	Negative
HKEQ	0	0	0	0	0	1
USEQ	0	0	0	2	0	0
ASEQ	0	0	0	0	0	0
JPEQ	0	0	0	0	0	0
PBEQ	0	0	0	0	0	0
EUEQ	0	0	0	0	0	0
GBEQ	2	0	2	0	0	0
Total	**2**	**0**	**2**	**2**	**0**	**1**

The table presents the number of individual funds that \have significant superior (positive) and inferior (negative) market-timing ability investigated by unconditional H-M model.

Table 5.4.3(a): Regression estimates of measures of market-timing: Conditional Treynor and Mazuy (T-M) model

Fund Group	Regression output	α	$b_{1,i}$ (Beta)	$b_{SAV,t}$	$b_{JAN,t}$	$b_{DIV,t}$	$b_{TERM,t}$	$b_{DEF,t}$	γ (Timing coefficient)	F-statistic	Adj. R^2
Panel A											
HKEQ	Coefficient	0.003	0.510	3.640	-0.135	7.711	3.582	5.863	-0.308	2077.75*	0.943
	t-statistic	4.558*	3.104*	1.598	-3.290*	2.264**	1.517	0.858	-2.091**		
USEQ	Coefficient	-0.001	0.633	7.454	0.229	2.906	3.000	10.395	-0.270	1305.74*	0.966
	t-statistic	-1.106	2.981*	2.393**	2.395**	0.596	0.987	1.021	-1.239		
ASEQ	Coefficient	0.003	0.160	10.995	-0.338	13.645	12.227	-8.996	-0.082	615.39*	0.924
	t-statistic	2.300**	0.507	2.488**	-3.982*	2.023**	2.703*	-0.725	-0.406		
JPEQ	Coefficient	0.000	0.366	5.305	-0.194	11.947	10.043	0.514	0.572	273.82*	0.944
	t-statistic	0.209	0.722	0.705	-1.449	1.121	1.461	0.021	0.867		
PBEQ	Coefficient	-0.003	0.211	0.013	-0.444	2.253	10.662	37.552	-0.430	88.34*	0.868
	t-statistic	-0.932	0.230	0.001	-1.410	0.117	0.815	1.122	-0.668		
EUEQ	Coefficient	0.002	0.164	8.244	0.026	3.832	5.666	41.941	-0.208	659.30*	0.957
	t-statistic	1.836***	0.622	2.192**	0.340	0.709	1.424	3.193*	-0.880		
GBEQ	Coefficient	0.001	0.395	3.549	0.276	2.811	6.904	22.106	-0.269	657.55*	0.878
	t-statistic	1.188	1.395	0.880	2.765*	0.483	1.670***	1.700***	-0.857		
Panel B											
All Funds	Coefficient	0.001	0.449	4.993	-0.122 -	4.586	5.748	15.375	-0.111	4588.33*	0.925
	t-statistic	2.788*	4.172*	3.309*	4.101*	2.074**	3.724*	3.380*	-1.229		

Panel A and panel B report the regression estimates of the conditional TM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta and the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + b_{1,i}\left(R_{m,t} - R_{f,t}\right) + b_{2,i}\left[z_t\left(R_{m,t} - R_{f,t}\right)\right] + \gamma\left(R_{m,t} - R_{f,t}\right)^2 + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t[th] month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. The vector of information variables, Z, includes the 1-month MPFA saving rate, January dummy variable, HSI dividend yield, maturity spread, and quality spread; $b'_{2,i} = \left(b_{SAV}, b_{JAN}, b_{DIV}, b_{TERM}, b_{DEF}\right)'$. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 5.4.3(b): Number of funds with significant timing ability by conditional T-M

	Significant at 10%		Significant at 5%		Significant at 1%	
Fund Group	Positive	Negative	Positive	Negative	Positive	Negative
HKEQ	0	0	0	1	0	1
USEQ	2	0	0	1	0	0
ASEQ	0	0	0	0	0	0
JPEQ	0	0	0	0	0	0
PBEQ	0	0	0	0	0	0
EUEQ	0	0	0	0	0	0
GBEQ	0	1	0	0	0	0
Total	**2**	**1**	**0**	**2**	**0**	**1**

The table presents the number of individual funds that have significant superior (positive) and inferior (negative) market-timing ability investigated by conditional T-M model.

Table 5.4.4(a): Regression estimates of measures of market-timing: Conditional Henriksson and Merton (H-M) model

Fund Group	Regression output	α	$b_{1,i}$ (Beta)	$b_{SAV,t}$	$b_{JAN,t}$	$b_{DIV,t}$	$b_{TERM,t}$	$b_{DEF,t}$
Panel A								
HKEQ	Coefficient	0.004	0.909	0.067	0.123	7.376	1.133	-19.977
	t-statistic	5.198*	1.956**	0.013	1.520	0.789	0.251	-1.821***
USEQ	Coefficient	0.000	0.592	11.000	0.572	8.166	7.460	-17.467
	t-statistic	0.446	1.917***	2.367**	4.665*	0.949	1.869***	-0.893
ASEQ	Coefficient	0.002	-0.383	17.189	0.205	29.222	12.340	-7.544
	t-statistic	0.889	-0.455	1.731***	0.861	1.290	1.620	-0.332
JPEQ	Coefficient	0.000	0.979	-5.308	-0.403	-10.381	6.347	25.428
	t-statistic	0.119	0.811	-0.339	-2.457**	-0.370	0.592	0.801
PBEQ	Coefficient	0.000	3.175	-34.761	-0.174	-44.003	-19.419	9.395
	t-statistic	-0.066	1.944***	-1.630	-0.388	-1.090	-0.992	0.152
EUEQ	Coefficient	0.001	-0.324	14.835	0.043	19.118	9.227	28.263
	t-statistic	0.775	-0.682	2.302**	0.417	1.598	1.592	1.209
GBEQ	Coefficient	0.000	-0.895	24.964	0.438	47.073	19.627	-45.330
	t-statistic	0.014	-2.092**	3.982*	3.339*	4.112*	3.470*	-1.820***
Panel B								
All Funds	Coefficient	0.001	0.173	9.585	0.149	16.666	7.993	-4.834
	t-statistic	2.484**	0.859	3.711*	3.044*	3.821*	3.383*	-0.659

Fund Group	Regression output	$g_{1,i}$ (Timing)	$g_{SAV,t}$	$g_{JAN,t}$	$g_{DIV,t}$	$g_{TERM,t}$	$g_{DEF,t}$	F-stat	Adj. R^2
Panel A									
HKEQ	Coefficient	-0.565	8.341	-0.320	-2.227	2.022	45.679	1254.81*	0.945
	t-statistic	-1.126	1.355	-3.393*	-0.218	0.369	3.200*		
USEQ	Coefficient	0.339	-3.347	-0.851	-15.602	-15.162	62.345	837.22*	0.969
	t-statistic	0.815	-0.514	-4.203*	-1.474	-2.332**	2.559**		
ASEQ	Coefficient	0.523	-6.447	-0.603	-14.208	1.197	-7.184	363.82*	0.925
	t-statistic	0.562	-0.553	-2.462**	-0.592	0.125	-0.262		
JPEQ	Coefficient	-0.147	-0.694	0.845	20.706	-2.062	-38.627	160.17*	0.944
	t-statistic	-0.106	-0.036	2.226**	0.675	-0.139	-0.826		
PBEQ	Coefficient	-4.469	54.666	-1.790	67.504	48.201	32.751	56.984*	0.878
	t-statistic	-2.228**	1.731***	-1.768***	1.466	1.865***	0.437		
EUEQ	Coefficient	0.820	-6.932	-0.154	-23.967	-8.589	26.766	382.29*	0.956
	t-statistic	1.369	-0.729	-0.625	-1.651	-0.893	0.817		
GBEQ	Coefficient	2.386	-35.991	-0.127	-70.358	-32.925	114.219	399.94*	0.883
	t-statistic	4.195*	-4.130*	-0.565	-5.099*	-3.732*	3.632*		
Panel B									
All Funds	Coefficient	0.341	-5.099	-0.411	-17.028	-3.041	31.797	2734.27*	0.926
	t-statistic	1.405	-1.510	-6.660*	-3.301*	-0.950	3.362*		

Panel A and panel B report the regression estimates of the conditional HM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta and the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + b_{1,i}(R_{m,t} - R_{f,t}) + b_{2,i}[z_t(R_{m,t} - R_{f,t})] + g_{1,i}[\delta \cdot (R_{m,t} - R_{f,t})]$$
$$+ g_{2,i}\{z_t[\delta(R_{m,t} - R_{f,t})]\} + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices, and the dummy delta $\delta_t = \{1 \text{ if } R_{m,t} > E(R_{m,t}), 0 \text{ otherwise}\}$. The conditional mean $E(R_{m,t})$ is estimated by performing a linear regression of the excess return of the various benchmarks on and the public information variables. The vector of information variables, Z, includes the 1-month MPFA saving rate, January dummy variable, HSI dividend yield, maturity spread, and quality spread; $b'_{2,i} = (b_{SAV}, b_{JAN}, b_{DIV}, b_{TERM}, b_{DEF})'$. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 5.4.4(b): Number of funds with significant timing ability by conditional H-M

	Significant at 10%		**Significant at 5%**		**Significant at 1%**	
Fund Group	Positive	Negative	Positive	Negative	Positive	Negative
HKEQ	0	0	0	1	0	0
USEQ	0	0	0	1	0	0
ASEQ	0	0	0	0	0	0
JPEQ	0	0	0	0	0	0
PBEQ	0	0	0	0	0	0
EUEQ	0	0	2	0	0	0
GBEQ	1	1	0	0	0	0
Total	**1**	**1**	**2**	**2**	**0**	**0**

The table presents the number of individual funds that have significant superior (positive) and inferior (negative) market-timing ability investigated by conditional H-M model.

Table 5.4.5: Distributions of timing coefficients found by different market-timing models

	Unconditional T-M (n=64)	Unconditional H-M (n=64)	Conditional T-M (n=62)	Conditional H-M (n=62)
Positive percentage	50.0	45.3	35.5	45.2
Negative percentage	50.0	54.7	64.5	54.8

The table presents the distribution of the timing coefficients of individual funds. The parenthetic numbers in the heading cells show the number of funds with sufficient monthly returns to run the respective models.

Table 5.4.6: Distributions of timing coefficients found by different market-timing models and classified by fund groups

	Unconditional T-M	Unconditional H-M	Conditional T-M	Conditional H-M
HKEQ	**(n=21)**	**(n=21)**	**(n=21)**	**(n=21)**
Positive %	47.6	42.9	33.3	52.4
Negative %	52.4	57.1	66.7	47.6
USEQ	**(n=8)**	**(n=8)**	**(n=8)**	**(n=8)**
Positive %	25.0	25.0	37.5	25.0
Negative %	75.0	75.0	62.5	75.0
ASEQ	**(n=9)**	**(n=9)**	**(n=7)**	**(n=7)**
Positive %	44.4	22.2	57.1	42.9
Negative %	55.6	77.8	42.9	57.1
JPEQ	**(n=3)**	**(n=3)**	**(n=3)**	**(n=3)**
Positive %	100.0	100.0	100.0	100.0
Negative %	0.0	0.0	0.0	0.0
PBEQ	**(n=2)**	**(n=2)**	**(n=2)**	**(n=2)**
Positive %	100.0	50.0	0.0	0.0
Negative %	0.0	50.0	100.0	100.0
EUEQ	**(n=5)**	**(n=5)**	**(n=5)**	**(n=5)**
Positive %	80.0	80.0	40.0	40.0
Negative %	20.0	20.0	60.0	60.0
GBEQ	**(n=16)**	**(n=16)**	**(n=16)**	**(n=16)**
Positive %	43.7	43.7	18.7	50.0
Negative %	56.3	56.3	81.3	50.0

The table presents the distribution of the timing coefficients of individual funds, split into different fund groups. The parenthetic numbers in the heading cells show the number of funds in the fund groups with sufficient monthly returns to run the respective models.

Table 5.4.7: Association between stock selection and market timing performance

	Unconditional T-M	Unconditional H-M	Conditional T-M	Conditional H-M
Correlation coefficient	-0.463*	-0.704*	-0.392	-0.018

The table presents the Pearson correlation coefficient computed to evaluate the association between the MPF fund managers' stock selection skill (measured by Jensen alpha) and market timing ability (measured by gamma run by different market timing model).

Table 5.4.8: Test for the differences between traditional and conditional timing coefficients found by T-M model

	All funds (n=62)	HKEQ (n=21)	USEQ (n=8)	ASEQ (n=7)	JPEQ (n=3)	PBEQ (n=2)	EUEQ (n=5)	GBEQ (n=16)
Parametric test:								
t-statistic	1.854	1.329	-1.273	0.258	1.595	2491.0	4.059	1.181
p-value (two-tailed)	0.069***	0.199	0.244	0.805	0.252	0.000*	0.015**	0.256
Nonparametric test:								
Wilcoxon *z*-statistic	-2.219	-0.991	-0.981	0.000	-1.604	-1.342	-2.032	-1.448
p-value (two-tailed)	0.026**	0.321	0.326	1.000	0.109	0.180	0.042**	0.148

The table presents the result of testing the hypothesis that the timing coefficient found by conditional T-M model is significantly different from the unconditional T-M model for all-fund portfolio and respective portfolios of different fund groups, tested by parametric paired t-test and nonparametric Wilcoxon matched-pairs test. The null hypothesis is set to be $H_0 : \mu_{\text{unconditional}\,\gamma} = \mu_{\text{conditional}\,\gamma}$ against the alternative $H_0 : \mu_{\text{unconditional}\,\gamma} \neq \mu_{\text{conditional}\,\gamma}$. Asterisks (*) indicate significant difference at 1% level, (**) indicate significant difference at 5% level, and (***) indicate significant difference at 10% level.

Table 5.4.9(a): Regression estimates of augmented measures of market-timing: Augmented Treynor and Mazuy (T-M) model

Fund Group	Regression output	α	β (Beta)	γ (Timing coefficient)	δ (Augment)	F-statistic	Adj. R^2
Panel A							
HKEQ	Coefficient t-statistic	0.003 5.416*	0.968 69.759*	-0.372 -2.637*	-3.547 -2.577*	4750.28*	0.942
USEQ	Coefficient t-statistic	-0.001 -0.729	0.977 47.397*	-0.610 -2.430**	0.106 0.036	2743.94*	0.962
ASEQ	Coefficient t-statistic	0.001 0.426	0.904 35.309*	0.380 1.438	4.572 2.113**	1373.67*	0.921
JPEQ	Coefficient t-statistic	0.001 0.343	1.103 23.941*	0.890 1.779***	0.456 0.064	613.62*	0.942
PBEQ	Coefficient t-statistic	-0.002 -0.796	1.053 15.570*	-0.356 -0.357	-10.312 -1.339	192.55*	0.861
EUEQ	Coefficient t-statistic	0.001 1.317	0.962 35.801*	0.238 1.108	-0.527 -0.224	1411.85*	0.953
GBEQ	Coefficient t-statistic	0.001 1.345	1.039 38.041*	-0.543 -1.465	-15.509 -3.471*	1508.69*	0.877
Panel B							
All funds	Coefficient t-statistic	0.001 3.219*	0.972 108.209*	-0.024 -0.253	-1.550 -1.696***	10520.18*	0.923

Panel A and panel B report the regression estimates of the augmented TM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta, the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, and the coefficient δ is the additional higher-order coefficient that should not be significant if the unconditional T-M model is appropriate, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot (R_{m,t} - R_{f,t})^2 + \delta \cdot (R_{m,t} - R_{f,t})^3 + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, and $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

Table 5.4.9(b): Number of funds with significant augmented variable

Fund Group	Significant at 10%	Significant at 5%	Significant at 1%
HKEQ	0	2	0
USEQ	0	3	2
ASEQ	1	2	0
JPEQ	0	0	0
PBEQ	0	0	0
EUEQ	1	0	0
GBEQ	0	2	0
Total	**2**	**9**	**2**

The table presents the number of individual funds that have significant superior (positive) and inferior (negative) market-timing ability, investigated by augmented T-M model.

Table 5.4.10(a): Regression estimates of augmented measures of market-timing: Augmented Henriksson and Merton (H-M) model

Fund Group	Regression output	α	β (Beta)	γ (Timing coefficient)	δ (Augment)	F-statistic	Adj. R^2
Panel A							
HKEQ	Coefficient	0.005	0.867	0.424	-0.154	4737.82*	0.942
	t-statistic	4.595*	24.447*	1.496	-2.110**		
USEQ	Coefficient	-0.001	1.033	-1.136	0.120	2753.89*	0.962
	t-statistic	-1.295	19.038*	-2.181**	1.056		
ASEQ	Coefficient	0.003	0.881	0.396	-0.143	1358.30*	0.920
	t-statistic	1.400	11.805*	0.767	-0.899		
JPEQ	Coefficient	0.002	1.051	1.371	-0.106	614.32*	0.942
	t-statistic	0.472	6.793*	0.958	-0.352		
PBEQ	Coefficient	0.005	0.634	3.460	-0.798	199.73*	0.865
	t-statistic	1.018	3.744*	2.636*	-2.180**		
EUEQ	Coefficient	0.002	0.936	0.417	-0.043	1412.11*	0.953
	t-statistic	0.943	13.091*	0.763	-0.293		
GBEQ	Coefficient	0.004	0.776	2.310	-0.415	1496.73*	0.876
	t-statistic	2.455**	10.924*	3.232*	-2.749*		
Panel B							
All funds	Coefficient	0.003	0.886	0.662	-0.159	10552.53*	0.924
	t-statistic	4.265*	36.865*	3.419*	-3.210*		

Panel A and panel B report the regression estimates of the augmented HM model to investigate the existence of market-timing ability for the respective portfolios of different fund groups and all-fund portfolio respectively. The intercept α is the measure of the alpha that indicates superior performance if it is positive, the coefficient β is an unconditional beta, the coefficient γ is the measure of the market-timing ability that indicates superior market-timing if it is positive and inferior if negative, and the coefficient δ is the additional higher-order coefficient that should not be significant if the unconditional H-M model is appropriate, from the following regression:

$$R_{i,t} - R_{f,t} = \alpha + \beta \cdot (R_{m,t} - R_{f,t}) + \gamma \cdot [D \cdot (R_{m,t} - R_{f,t})] + \delta \cdot (R_{m,t} - R_{f,t})^2 + e_t$$

where $R_{i,t}$ is the monthly return of the funds in the t^{th} month, , $R_{m,t}$ is the monthly return on the mean-variance efficient market portfolio, i.e. the benchmark indices, and D is the dummy variable equals -1 if $R_{m,t} - R_{i,t}$ is negative and 0 otherwise. Asterisks (*) indicate significant at 1% level, (**) indicate significant at 5% level, and (***) indicate significant at 10% level.

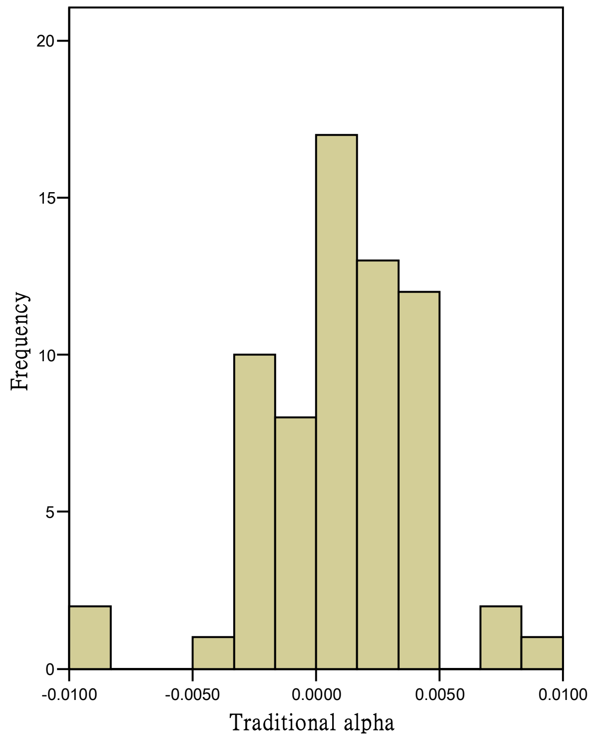
Table 5.4.10(b): Number of funds with significant augmented variable

Fund Group	Significant at 10%	Significant at 5%	Significant at 1%
HKEQ	0	0	0
USEQ	1	3	0
ASEQ	0	0	0
JPEQ	0	0	0
PBEQ	1	0	0
EUEQ	0	0	0
GBEQ	0	0	2
Total	**2**	**3**	**2**

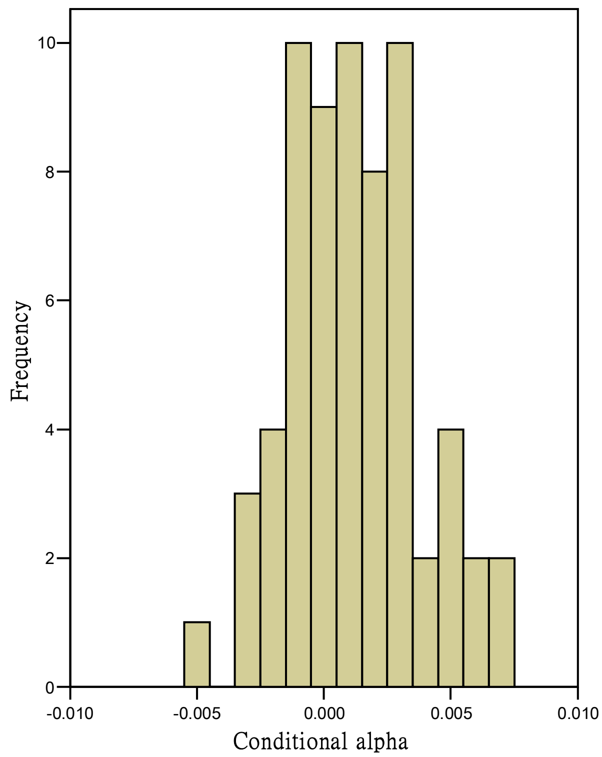
The table presents the number of individual funds that have significant superior (positive) and inferior (negative) market-timing ability, investigated by augmented H-M model.

APPENDIX B: FIGURES

Figure 3.4.1: Distribution of alphas

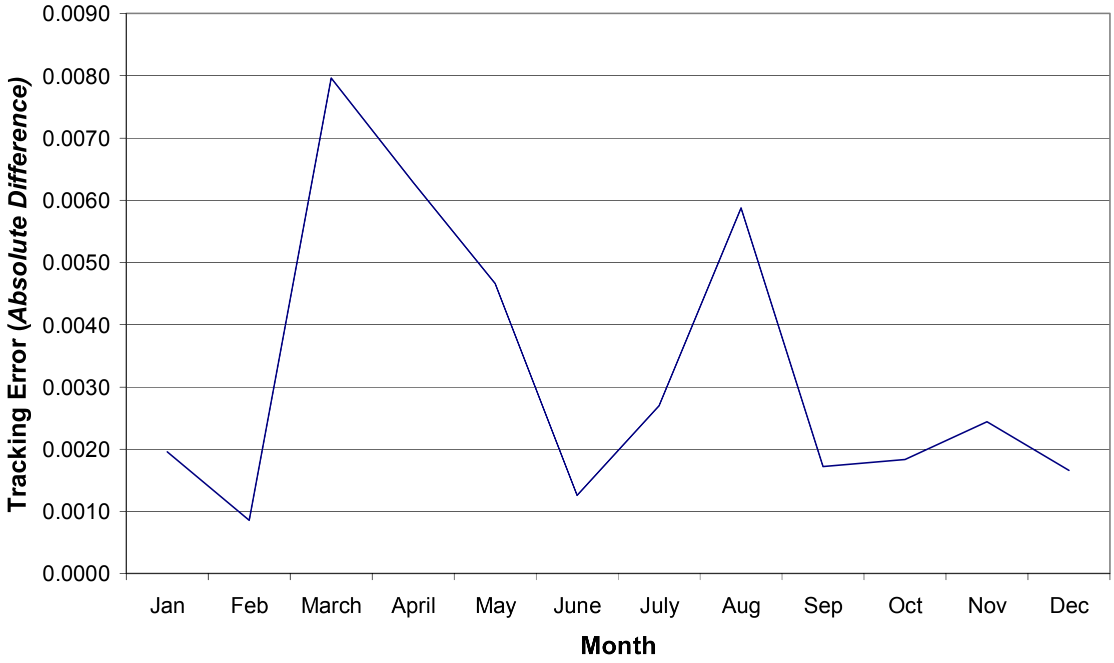


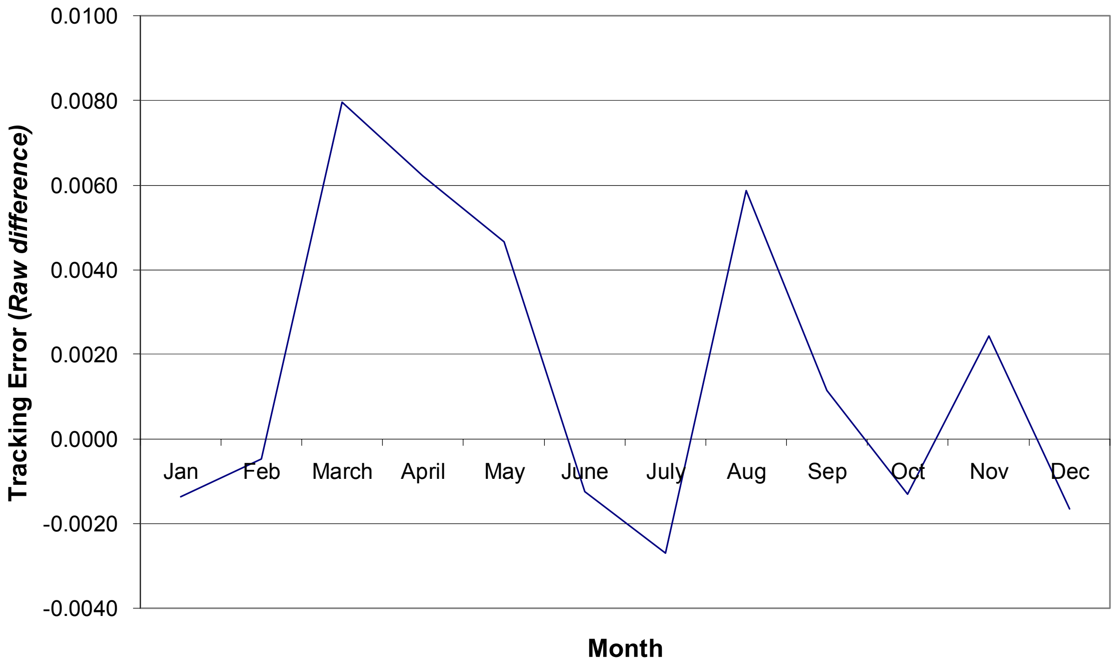
Skewness coefficient: -0.410



Skewness coefficient: 0.215

Figure 3.4.2: Average tracking error of every calendar month





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